
THE
OMEN
Loves
You
PANDA

Table of Contents

For the sixth issue in the 34th Volume of the Omen on April 16th in the Year of our Lord 2010

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"If we've been in the Omen office for 12 hours, does that count as an all-nighter?"
David Axel Kurtz

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EDITORIAL

...ATQVE VALE

by David Axel Kurtz

"You are just going to waste an hour trying to write a suitably valedictory editorial, and then fail utterly." So saith Evan Silberman. And he is right.

In my four years here I have published at least fifty articles in The Omen.[1] Some of these have had word counts which ran into the quintuple digits.[2] I've put about five hundred thousand words of prose up on my web site.[3] I've written four novels, none of which suffer from a dearth of prolixity.[4] I've filled well over a thousand pages with acadmic prose.[5] And now I've discovered the wondrous joy that comes from abusing footnotes.[6]

But still...

...still...

...something valedictory? Something that might act as a summation to my Hampshire career?

No. Nothing. Not at fucking all.

So let me see what I can say of these four years before the mast:

Here rests his head upon the lap of Earth
A youth to Fortune and to Fame unknown.
Fair Science frowned not on his humble birth,
And Melacholy marked him for her own.

Large was his bounty, and his soul sincere,
Heaven did a recompense as largely send:
He gave to Misery all he had, a tear,
He gained from Heaven ('twas all he wish'd) a friend.

No farther seek his merits to disclose,
Or draw his frailties from their dread abode
(There they alike in trembling hope repose),
The bosom of his Father and his God.

-Not me. Gray's Elegy. *READ A BOOK.*

1 Sorry, Omen readers
2 Sorry, Hampshire community
3 Sorry, internets
4 Sorry, literary agents
5 Sorry, Hampshire professors
6 Sorry, David Foster Wallace

Policy

The Omen is a biweekly publication that is the world's only example of the consistent application of a straightforward policy: we publish all signed submissions from members of the Hampshire community that are not libelous. Send us your impassioned yet poorly-thought-out rants, self-insertion fan fiction, MS Paint comics, and whiny emo poetry: we'll publish it all, and we're happy to do it. The Omen is about giving you a voice, no matter how little you deserve it. Since its founding in December of 1992 by Stephanie Cole, the Omen has hardly ever missed an issue, making it Hampshire's longest-running publication.

Your Omen submission (you're submitting right now, right?) might not be edited, and we can't promise any spellchecking either, so any horrendous mistakes are your fault, not ours. We do promise not to insert comical spelling mistakes in submissions to make you look foolish. Your submission must include your real name: an open forum comes with a responsibility to take ownership of your views. (Note: Views expressed in the Omen do not necessarily reflect the views of the Omen editor, the Omen staff, or anyone, anywhere, living or dead.)

The Omen staff consists of whoever shows up for Omen layout, which usually takes place on alternate Friday nights in the basement of Merrill on a computer with an extremely inadequate monitor. You should come. We don't bite. You can find the Omen on other Fridays in Saga, the post office, or on the door of your mod.

The Omen Tanka

Views in the Omen (5)

Do not necessarily (7)

Reflect the staff's views (5)

Though none will be much surprised (7)

If they do. (for great justice) (7)

SECTION
HATE

Sexual Ethics in the Modern Collegiate Environment.

by David Axel Kurtz[1]

1 footnotes by Ian McEwen – *ed.*

Underground

I wrote this essay because I wanted to examine the issue. I think it is an important issue, interesting, complicated, and well worthy of discussion.

The conclusions that I come to in this essay are the best conclusions I could draw, given the data at hand. They will probably seem cold and harsh. They sure seem so to me.

Perhaps if the system that we now have is left to its own devices, it will improve to the point where no boys or girls will ever get taken advantage of.

Or perhaps the only thing that will bring this about is a complete overhaul of the system, cold and harsh though it may need to be.

Like I said, I think this is a topic worthy of discussion. So let's discuss it.

I mean – hell – beats working on my Div III.[1]

Background

I expect that every person who is sexually active – and no few of those who aspire to be – turn their mind, at one time or another, to consideration of sexual ethics. This is as understandable as a person who, aspiring to play baseball, learns how to swing a bat; or wanting to play poker, learns which combinations of cards will form a winning hand; or wanting to fly a kite, studies the physics of flight that allows their kite to loft into the sky. In a society where human interactions are governed by social taboos, by human laws, and by natural laws, a person who is sexually active would be foolhardy indeed if they did not learn what is illegal, what is impossible, and what is just unlikely to get them laid.

The traditional issues of sexual ethics concern whether or not a person is capable of consenting to sexual acts. This calls into question their mental state, thus to be able to understand the nature of the activity, or propositions thereof; their maturity, thus to be able to come to a respectable decision when presented with such a choice; and their freedom, thus to be able to express their choice, and to do so without fear of reprisal.

These aspects of traditional sexual ethics can be easily illustrated by a series of situational dilemmas. I should like to state clearly that the genders of the various participants in these scenarios were distributed entirely at random.

What if a man encounters a woman who obviously suffers from some sort of mental handicap – she might yield to his advances, or even encourage them, but is he right in pursuing them, considering the nature of her cognitive limitations? What if a woman desires a man who is too young to be considered an adult; could he be counted upon to understand the ramifications of his decisions, being sexually capable but not yet allowed even to drive a car? What if a man attempts to seduce a man who is subordinate to him in the workplace; could the subordinate hope to escape these advances without alienating his superior, and thus his hopes for advancement, or even job security? What if one woman is so physically imposing that the object of her desires would feel unsafe in denying them, even there have been no explicit threats made against her?

These are worrying issues to many, and it is many who have encountered them.

The law provides a framework for dealing with such situations on a general level. In the first example, a person cannot legally engage in sexual intercourse with a mentally handicapped individual, should a court determine that this person was unable to intelligently consent to such activity. This of course would only rise as an issue

1 What Div III? – *ed.*

if complaint was made, yet due to these circumstances a complaint might be considered even if it did not originate with, nor was even condoned, by the mentally handicapped person. Thus there is an element of risk to any such endeavor, for its legality is based upon an evaluation of a person's reasoning made by someone with no medical training nor direct involvement in the life of the individual. Yet it is generally assumed that sexual activities between people in full control of their faculties cannot be called into question.

In the second example, the particular ages of consent are set arbitrarily by law, and vary between jurisdictions. They take into account the age, sometimes of the youngest party, sometimes of both parties, evaluating them both absolutely and in relation to each other. Yet it is generally assumed that sexual activities between 'consenting adults' – that is to say, two or more people each over the age of eighteen – cannot be called into question. From one day to the next, a seventeen-year-old jailbait becomes an eighteen-year-old target of opportunity.

In the third example, it is generally held that a person cannot pursue a sexual relationship with a subordinate in the workplace. Likely a superior could not allow themselves to be pursued by a subordinate. Most often two people of equal rank in a corporate hierarchy could not pursue either a torrid love affair or a platonic romance. If any of these situations were allowed, all parties would leave themselves in an actionable position, no party more so than the company itself.

In the fourth example, it seems unlikely that the intimidated woman would be able to prosecute her intimidator if, after consenting to sexual intercourse, she then claimed she was not able to give consent. If the intimidtor was explicit in her intimidations, threatening reprisals for a scorned advance, or using violence or physical force as direct coercion, then this would clearly be considered as rape. Without such explicit terrorization or use of force, any post facto objections would be no different than waking up with a severe case of Awfuck's Disease.[2]

In fact, in all four of the aforementioned scenarios – sex with a minor, sex with someone of a minor's mental abilities, sex with a subordinate, or forced subordination – the general rule of law would suggest that these would be situations of rape, that one party in these situations would be called a rapist, one a victim, and that the crime could result in the rapist's imprisonment, subsequent impoverishment, and all other manner of mandated nastiness.

Yet these are all extreme examples; their invocation is the connubial equivalent of Godwin's Law. Oftentimes in sexual situations, as in any situations wherein two people – not ideologies nor abstractions but people – have occasion to interact, the ethical considerations are far more complicated, and one's judgments cannot be quite so easily passed.

What if intercourse was had between two people who are both mentally handicapped? Or what if it is simply between a person who is not at all intelligent, and very little educated, and one who is of extreme intelligence and high education? In the former instance there would be a situation at least of equitability; in the second, the power dynamic would drastically favor one of the people above the other. It is highly unlikely the law would declare a rape to have occurred in either instance, but could it be said that either situation was one of ethical superlativity, subject to, if not legal proscription, than at least ethical abhorrence?

What if the intercourse was between two people with significant age disparity between them? What if the pursuer was a person in her forties, the pursued a person just a few days over eighteen – still, perhaps, in high school? What if a fourteen-year-old of particular maturity, both physical and mental, as well as deviousness and means, were to pursue an eighteen-year-old who lacked all of these gifts? In the former situation, it seems unlikely that a criminal act would have taken place; in the latter, it is distinctly possible that the eighteen-year-old could be prosecuted for a crime, and the fourteen-year-old called the victim of that crime, without consideration of the sexual agency of the people involved in the liaison.

What if the intercourse was initiated by a person in the mail-room, who captured the heart of a senior executive? What if these two people went out for coffee to discuss their work, then again to discuss a movie, then again to discuss themselves; and after time, a romance blossomed, and for all the good it might do their case they were married to each other before so much as brushing lips? What of a person who sleeps with a subordinate, and then promotes somebody else over her, relying upon judgments of professional rather than acrobatic ability to guide their managerial decisions? It would seem likely that a crime could have been committed in any one of these situations, even those wherein no particular damage was caused. Moreover it would be easy for a person to claim damages in any of these situations, and pursue the matter, if not criminally, than at least civilly – and quite remuneratively.

The final situation, in the urgentness of its means,

2 Paraphrased from the author: Awfuck's Disease: when one wakes up, turns one's head to their bed-companion, and says "Aw, fuck." –*ed.*

seems to necessitate fewer discussions of ethics, but some problem situations might be considered. What of a person who, mid-coitus, suddenly determines that they are bored, and ask their partner to stop; if the partner does not, is the first half of the sex a thing of beauty, and the second half, a hideous crime punishable with lengthy incarceration? Conversely, if a seven-foot and three-hundred-pound body-builder, perhaps a doctor of philosophy to boot, was to corner a five-foot hundred-pound writer of Harry Potter fan fiction, could there ever exist between them a power balance sufficiently equitable for their liason dangereuse to be called ethically sound?

Yet there is no negotiation in which both parties arrive at the bargaining table with a perfectly equal position. Else there would be no negotiation; a ten dollar bill would be exchanged for a ten dollar bill, or like displays of the transitive[3] nature of equality. The bargaining table is not a place for determining equality, but rather, for determining equivalence. If one party offers a certain quantity of money, and the other, some good or service, and the two are exchanged, it can thus be said that the purchaser values their purchase at at least the price paid.

Nothing more.

To induct from this that the market values this item at this exact price (or worse, that the item is somehow absolutely valued at this price) is more than just the fallacy of the black swan, more than just the fantastical silliness of the ceteris paribus arguments and pari passau posits which make academic exercises so uselessly academic. These two items are made equivalent only in the eyes of their respective parties; they are equal only above the trading-table, and nowhere else. If similar bargains are struck over and over again, one might draw conclusions from this pattern of equivalences, from which larger presumptions (as for predictive purposes; that is to say, guessing) might be drawn. But these good-values are determined, at the end of the day, by people. By exchanges; by the friction between two parties; by people. To build upon their subjective appraisals the foundation of absolute valuations is to create a rational system based upon irrational inputs; it is to make a jungle primeval, and call it peace.

Yet it is this very practice which is the goal, or at least the result, of one who works to restrict the natural course of trade. Such a person wishes, not only to create such definitions, but to enforce them. One may separate a law from a market event, and name as Communists those who seek such restrictions; or call such restrictions simply another form of market event, decided upon by the very market which it shall affect, and call these people Capitalists (with perhaps a slightly monopolistic flavor, as pluralistic democracy provides). Yet whatever the nobility of their goals, or the thought that they have given to that which they shall affect, these people who restrict the free flow of trade do substantively alter the marketplace upon which they practice. They constrain the flow of goods. They create swells or slumps of demand, excesses or dearths of supply. The result is unbalance, inefficiency – and, as people are involved, a necessarily quanta of unhappiness.

There is a hypothesis often maintained that the capitalist system is simply the extension of the state of nature from the realm of blood and zygotes to the land of stocks and bonds. Therefore do the rules of Darwinian selection apply just as fiercely to a corporation as to a species, or a specimen. The result of being immersed in this process is that the corporation which is, even for a moment, triumphant, is the one which has adapted the most successfully to the situation in which it finds itself. The situation, and nothing more, determines fitness, and survival.

A collegiate environment is a rather fixed situation, becoming ever more so as colleges develop more sophisticated and regimented legislation for their self-gover-

3 I think that word does not mean what you think it does, Mr. Kurtz. –*ed.*

nance, as is the trend at schools throughout the country.[4] Those who succeed in a collegiate situation, as in any other, are those who have adapted to it the most completely. A person might be a king or queen of the collegiate situation to make Van Valen's Red Queen turn green with envy. That person's reign might still be greater or lesser as their demesne be better or worse. To adapt to a collegiate situation which has itself no bearing upon the functioning of the world beyond college is certainly nonproductive, likewise counterproductive, and hardly the best possible use of the eight semesters given a person in their life. This is the tragedy of Charlotte Simmons, and of thousands if not millions of American youths every academic year.

It is acknowledged that a college determines the nature of the students who pass through it. This is true in the classroom, in the dining hall, on the sports field, in the students center (if your college is blessed with such a thing). It is no less true that the college's attitudes towards sex and consent, be they cultural, ethical, or legal, shall likewise shape the attitudes and behaviors of those people who matriculate thereat. It shall shape them as they are enrolled in their school, and follow them as well out into the world beyond.

School-grounds

The modern collegiate situation provides no little opportunity for people to enter into sexual relationships. A school shall have anywhere from hundreds to tens of thousands of students. The vast majority of these shall be nubile, hormonally charged, and placed in close proximity to each other. They shall be united in their desire for experimentation, for adventure, for the relief of boredom, and for the discovery of security and acceptance as a lover's arms might easily provide. It is duly worth noting that, at many if not most of these institutions of higher learning, these students shall have little else with which to fill their time, and little opposition to so abhorring this vacuum.

Moreover, it might be observed that, all things being equal, sex is fun. It can be a really great way to spend some time. One of the best, I might say.[5] In situations where everything is provided for a person; where their life and health are guaranteed; where their situation is secured, often for many years to come; where little they can do will jeopardize this security; where life, in short, at odds with Hobbes, is sociable, opulent, comforting, languorous, and long; little necessary incentive exists for them to deny themselves such hedonism. In a world, or at least an academic environment, which no longer stresses the appreciation of other things higher than such bounteous bacchanalia, it is unsurprising that students fornicate with such merry aplomb. In leisure they are the equal to the aristocrats of yore; it would be foolhardy to expect that they would behave themselves better than did their predecessors in the court of Nero, in the halls of Versailles, in the roar of the '20s, ad nobilitam.

A modern student might even have fewer constraints upon them than did burden their noble antecedents. The laws of the land are in many ways more relaxed, particularly as dueling is now illegal, intercourse out of wedlock commonplace, and adultery a legal fiction on which many jurisdictions waste little of their imaginations. The necessity of marriage has been discarded, even in instances of conception, and the benefits of science have allowed for such instances to be avoided with exceptional efficacy. This to say nothing of the technology regarding the avoidance of diseases. This to say nothing of the technology regarding the increase of sexual pleasure – or at least of its variety, accessibility, and plurality.

Yet a person who seeks pleasure between the sheets is likely to seek pleasure in other areas. The modern collegiate environment is no less sybaritic than other decadent locations of past times; it would be naïve to expect it to be any less intoxicated. Not when modern technology, and the unification of the disparate parts of the world, both allow for a common college student to have access to psychoactives and inebriates of which previous generations could barely hope to dream. It should also be considered that only the elites of elites in previous generations could have hoped to have access to the copious quantities of stupifacients from which a modern middle-class child might easily draw. A modern person might also understand the effects of such things much more fully, likewise recover from them with superior easiness and grace.

Easy sex, and lots of booze: this is the situation in which the modern collegiate finds themselves. Therefore the ethical questions which arise when these two hedonisms become concurrent are of paramount import to all modern undergraduates. At least on Friday and Saturday nights. If not on all nights of the week, and days and mornings too.

Most of the ethically dubious situations outlined in Part I of this essay relate to instances of an imbalance of power. When taken to extremes this results in the inability of one or more partner in a sexual exchange to give consent. The recreational consumption of inebriates ne-

4 At least Hampshire doesn't have sophistication or regimentation, amirite? –*ed.*

5 You say this even after the aftermath of your past couple girlfriends? Amazing. –*ed.*

cessitates a decrease in a person's mental faculties, a like decrease in their physical abilities, and a potential alteration in their natural desires. These are all effects which, if they were organic of origin, would seriously call into question the ethicalness (unto prosecutability) of a sober party's instigation of a sexual union.

Yet in this consideration these reductions are not organic of origin. The person is not born with a mental handicap; they did, of sound and competent mind, knowing full well the consequences of their actions, choose to make their minds both unsound and incompetent. They chose to lower their guards, to relax their inhibitions, to render themselves less than fully capable of making decisions relating particularly to their own sexual behavior. They chose to emulate those who Law and Society declare are not able to give consent to sexual behavior – yet they chose to so emulate, consciously, consensually, and of their own free will.

Therefore do the ethical questions regarding such a situation become complicated. For ought a person then to be judged based upon the rules which apply to the handicapped, the impaired, the unconscious – in short, those incapable of giving consent? Or ought they to be judged based upon the rules which apply, not to the intoxicated person that they are, but to the person who chose to become intoxicated – the person they shall soon be again – a person of normal faculties and evaluatory abilities, who can be assumed able to give free consent, and thus be held responsible for their actions, and the choices that they make?

In the United States, in an instance wherein harm is done by an intoxicated person, their intoxication cannot be considered a mitigating factor. A drunk driver who gets in an accident is treated with even harsher contempt than a sober driver who gets in the same accident. The person is judged as being, not only responsible for the accident, but responsible for acting in such a way that they were incapable of preventing the accident. They should have known better. They should have acted better. They are responsible. They will be punished accordingly.[6]

Yet at the modern undergraduate institution, an intoxicated person would hardly seem to be held to this standard. They are not punished for their behavior. If anything, they are protected because of it.

A college student is not allowed to autointoxicate beyond measure and without repercussions. They have to obey a modicum of decorum, particularly before they turn 21. Yet it would seem that, in most cases, the student will only be punished for intoxicatory behavior when it is necessary that they be punished. That is: once their drinking, or what-have-you, becomes a risk either to them or to others.

As in psychology, where an aberration is only considered to be a pathology once it is damaging to the individual or those around them, so too is treated the abuse of inebriates by students at a modern undergraduate institution. It is seen as a medical difficulty; that is, it is only a difficulty when the medics have to be called, and not a moment before.

This dichotomy[7] extends to issues of sexual consent. A person with a mental handicap might be judged incapable of giving consent to sexual acts, thus protecting them from those who would seek to take advantage of them by threatening to punish those who do. So too is an adult, who makes themselves equivalently reduced in abilities through the consumption of drugs or alcohol, considered equally inviolate by the laws and customs of their college.

It should be noted here that the students herein references are most likely adults of legal, physical, and mental competence. They are not children. They are not held to be children. Outside of academic environs they would be expected to provide for themselves, protect themselves, control themselves, and ought to be well capable of so doing. They are old enough to join up or be drafted, thus to serve, to protect their country, to die for it. They are

6 Except, of course, if they, rather than getting arrested, instead drive drunk and then wake up the next fucking morning in a fucking cornfield.

You fucker you. –*ed.*

7 Oh man, that word. Someone wrote that in the bathroom off the Upper RCC, as part of some longer thing that I never really bother to read. But then, of course, someone changed it. To "dickotomy." Someone later added "perhaps you should begin by defining "dickotomy."

Okay, seriously guys. Not that hard. Etymology! It's your fucking friend. Two parts: the second, 'tom,' from the Greek, means 'to cut.' The first, 'dick,' from the streets, means 'penis.' Whatever asshole wrote it was talking about *chopping off penises.*

There is, of course, more graffiti in that bathroom. One of the more high-quality ones is the "toilet tennis" one, in which the right side (when sitting on the can) reads "Toilet tennis: look left," and the left "Toilet tennis: look right." Embarrasingly, given that I'm usually standing at said toilet, I was initially very confused as to how someone could mess up those directions, given they're half the point. Then I sat down once. Whoops.

A third piece, on the door, reads "can the subaltern txt?" What the shit is the subaltern, and why would it be able to 'txt?' –*ed.*

adults, in every sense of the word.

Despite this ownership of personal responsibility, a drunk person, or a stoned person, or a student otherwise fucked up, is afforded protected status by their college. They have made themselves incapable of protecting themselves. Thus they are protected by those around them.

This is not a necessarily causal relationship. However much an academic environment, moral to the hilt, might abhor this vacuum of security, nature does not.

These students are not punished at all for behaving in such a manner that they become more likely to be taken advantage of, or otherwise make themselves less capable of giving fully informed consent. Indeed, by seeking to remove the risk from such behavior, they are if anything encouraged in it by their school. There is no greater enabler to undergraduate excess than undergraduate institutions.

Thus if a person gets drunk, goes driving, and hits someone, the fault is the drunk's. Yet if a person gets drunk, goes to a frat party, and has sex, the fault is not considered theirs. In such a situation, it is quite likely that there would be particular blame attached to the person who has had sex with them, leaving them open to prosecution through the college judicial system,[8] if not through the criminal courts as well.

Let us examine a few situations in particular. In the first, a girl goes to a party with clear intentions to get drunk and have sex. She gets drunk and then some sober guy propositions her. She agrees, they go somewhere, and have sex. Chances are it's not very good sex, but that's beside the point.

The second situation has a guy going to a party wanting to get drunk and have sex. He gets drunk and then some drunk girl comes on to him. They go somewhere and have drunksex.

In the third situation, a girl goes to a party desiring to get really drunk, but has no desire for sex. She gets really drunk and some girl propositions her. In the midst of an alcoholic fog, she agrees, and they go at it.

In the fourth situation, a guy goes to a party desiring to get really drunk and pass out. He does a half-dozen keg stands, and passes out. At some point in his blackout someone has sex with him. He is given no opportunity for consent.

I would like again to stress that the genders in the aforegiven situations were distributed randomly. I have also relied on two-person couplings, primarily because they are simpler to deal with, but also because the discussions which apply to them might be easily applied to situations of polyamory.

The variables in these situations are threefold. First, there is the question of who is the primary pursuer in the situation, what might be called the sexual agent. Second, there is the question of the intents of the people involved when sober. Third is the question of the intents of the people involved when intoxicated. Each of these variables must be considered in each of the examples given above.

In the first situation, the girl's desires when sober are for sex. Her desires when drunk are the same. It would seem that, if she has sex while drunk, she has no grounds upon which to complain. In fact, she would seem to have had a pretty good evening, by her own given standards.

Yet in this situation, unless the girl and the guy clearly negotiated things when both were sober, this would be a situation which could easily be called nonconsensual sex – that is to say, rape. The guy in this situation, being sober, is considered to be in a necessarily more powerful position than the drunken girl, so much so that no negotiation into which they enter could possibly be equitable. Therefore it is thought that their sex is unethical. That the guy in this situation would be well open for punishment, certainly suspension or expulsion. The only thing keeping him from such punishment is the hope that the girl doesn't change her mind the next morning.

Therefore, in such a situation, according to the lights of collegiate morality and legality, the onus of responsibility would fall upon the man, not only to avoid pursuing this woman, but also to reject any advances she might make. The sexual responsibility is not shared equally between the two people, let alone considered to be more on the shoulders of the person who has intentionally rendered themselves defenseless; it is made to rest entirely upon the only person in this exchange who has elected to remain in full control of their faculties.

One might wonder whether the modern university, seeing that some of its students are lowering their levels of functionality and intelligence, believe it best to insist that everyone seek, through their thoughts and actions, to meet this lowest common denominator.

In the second instance, both partners in the affair are equally intoxicated at the time of negotiation, likewise consummation. Yet we only know that one of them, the man in this case, was actually desirous of finding a sexual partner while he was still sober. They are both equally incapable of giving sober consent at the time when the proposition is made. Is a drunk person thus considered incapable of judging whether or not they want to have sex, but is still required to be responsible for restraining themselves from pursuing sex? Is consent a passive de-

8 ... speaking of shit Hampshire doesn't have. –*ed.*

vice, wherein the one who seeks it is responsible for their actions, whereas the one from whom it is sought is worthy of being treated as a protected entity?

Is intoxication a mitigating circumstance in the pursuit of sex with another intoxicated person? Or does drunkenness protect the pursued, but not the pursuer? If a driver is drunk, but driving acceptably well, and hits a drunk pedestrian who is wandering aimlessly down the middle of the road, whose drunkenness would be at fault for the accident?

In the third situation, the girl's desires for sex are changed as a result of her consumption of intoxicants. She knew full well – or at least, it was her responsibility to know, perhaps even the responsibility of the college to inform her – that intoxication might lead her to consent to things which she might not otherwise consent to when sober. Still she chose to become intoxicated.

Who ought the woman pursuing her then listen to? The sober girl, some many hours ago, who wanted to go to bed alone? Or the girl right in front of her, hitting on her, an adult who desires sex?

This begs the question: what if the person desired, when sober, to get drunk and then have sex, and yet they find, once drunk, they no longer desire it? Can a person then demand sex of them, knowing that their sober self has better judgment than their drunk self? Or is a drunk person able to refuse consent, but not to give it?

In the fourth situation, a guy goes to a party specifically desiring to pass out. When unconscious, someone has sex with him. This is the most extreme example of intoxicated sex, and would universally be called rape, the sexual agent a rapist, and he subject to both collegiate and criminal prosecution.

Yet this situation, an argument reductio ad maleficum in the Godwin's Law sense, may more than any of these other situations clearly demonstrate the ethical complexities of combining sexual agency with intoxicatory agency. For the person may have not desired sex when sober, is certainly not in any position to desire anything, let alone consent to anything, when shithoused intoxicated, and therefore have clearly been taken advantage of sexually. As they were not involved in the sexual process, the sex in which they were involved was not their fault. They were not a sexual agent. It was not their fault.

Yet was it their responsibility?

It should be clearly known to anyone, of any age, of any gender, that they do not have to be an active agent in order to engage in sexual play. The human body may be used for sex without the consent, or even participation, of the consciousness which resides in that body. When a person consumes intoxicants to the point where that consciousness leaves the body, they are in no position to defend themselves. In such a situation they must either make sure that they shall, in their inebriated state, be left entirely alone; or else they must assume that, in such a state, it is distinctly possible they shall be taken advantage of, sexually or in any number of other ways.

In order to structure the situation so that they can assure they will not be taken advantage of, the person must go to great lengths in the planning of their intoxication. They must, essentially, drink alone, and behind a locked door at that. This presents other complications that threaten the health of the drinker. Or they could include in their revelry only such people as they trust implicitly – yet in transferring responsibility for their safety to the shoulders of their friends, they are implicitly abdicating responsibility for themselves.

Therefore the responsibility for establishing such a safe space for intoxication is on the shoulders of the person becoming intoxicated. If they do not establish such a space, such as is proved by their being taken advantage of sexually, that is their failure towards themselves. If they get drunk and pass out, say, at a frat party, or in some similar venue, they should not be surprised if their defenselessness is taken advantage of by those not similarly devoid of conscious volition.

They might then be disappointed in the world around them, particularly the person who so took advantage of them. They might certainly be disappointed in themselves, for failing to understand the consequences of their actions. Yet to appeal to the laws of man to protect them, when they have clearly acted so as to shirk off any responsibility for self-protection, is more than simply a cowardly and slavish bargain; it is one that is not likely to keep them safe.

From the perspective of the law, intoxication denotes a denial of consent. Yet from the perspective of the natural world, intoxication denotes consent.

It is in the conflict between these two factors that arise the ethical objections examined in this essay.

Foreground

The recreational consumption of inebriates, and a subjection to nonconsensual sexual behavior, are strongly and explicably connected. It is therefore concluded that a person who indulges in the former is, if not consenting to such exploitation by the rule of law, then certainly inviting it by all the rules of nature and of man.

It follows that their environment, if it be responsible

for their wellbeing, ought not to condone their behavior, nor surely to reward it; and if it be educational in design, ought to lead them with steady hand towards its considered condemnation.

If a person wishes to minimize the chances of their being coerced, or forced,[9] into any sort of behavior, they must seek to minimize those things which would make them more easily coerced or forced. The imbibing of drugs and alcohol, whose primary effect upon the human body is to weaken their body and will, is directly anathema to this idea. To rely upon others for one's own safety is a gamble at best. Relying on their self-interest, by relying upon the punishments of the law, is a risky gamble; relying on their morality, as expressed in their sense of self-restraint, is a gamble of almost irrationally poor odds of success.

When dealing with an issue as complex as sexual ethics, and as potent as sexual gratification, it seems poorly considered that the laws should seek to increase these microscopic odds. At best they shall make it less likely that things of this nature will occur, but they shall never banish entirely the beast of nature, for in nature does the human beast continue to dwell.

If one does not enjoy such calcified calculations, one can rely on the easy determination that humanity's none-too-limited efforts in this area have proven remarkably unsuccessful, in fact they suck, and therefore a new strategy ought from necessity to be considered.

Perhaps it would even be of societal benefit if people were not legally protected for engaging in self-diminishing and self-abnegating behavior. It requires no support of eugenics to perceive that this may well be of detriment to human society, as a whole and over the horizon of generations. It can be determined from examining the success of the species that humans shall adapt to whatever situations they find themselves within. It thus falls to humanity, select amongst all creatures in that it can determine to a great extent its own situation, to determine the situation to which it ought best to adapt.

In the current situation, one wonders why there is so much trouble: so much rape, and beyond, so much drinking.

The laws and morals of a modern college environment do to a great extent protect those who have specifically ceased to protect themselves. Their law provides explicit positive reinforcement to those who wish to become intoxicated. The judicial forces of a modern collegiate environment are the greatest enabler to binge drinking, underage drinking, drug-using, &c,[10] that has ever existed. Those who seek to know why the students of today practice such extremes of chemical hedonism,[11] look no further.

We have little work, and so can fill the hours with such play. Preferring play, we choose classes which give us less work, setting the bar ever lower for all students. What work we have is not difficult, giving us leave to do it while under the influence. We choose classes with easy work, thus perpetuating the farce of our educations.

The reward for us doing our work is to play. We are given the opportunity to increase the latter by diminishing the former. It does not speak well of us that these are our priorities; but given that they are, can we at all be faulted for pursuing them with such commendable efficiency?

Seeing that this is the choice we have made, the College seeks then to reinforce it. They are not so universally assisting, or even condoning, of our actions. Yet they are given no legal framework, and little ethical guidelines, for doing otherwise. Rape is a crime; blind hedonism is not. Allowing students to do that which they desire is supportive; preventing students from suffering that which they do not desire is likewise.

Knowing no better, and having no higher desires, college students seek only to perpetuate the status quo. It is hard to criticize them for, being given the opportunity to vote themselves bread and circuses, taking advantage of that fact, as so many have done before. It is a rare type

9 Yes, those are largely synonyms. Congratulations. –*ed.*

10 I'm sure Molly McLeod approves of this usage. –*ed.*

11 You used that big word already. –*ed.*

of person who can vote down such an easy triumph. It is a rare person indeed who would voluntarily dismiss pleasure, and bring upon themselves challenges and responsibilities, where they might instead just fuck and then pass out.

It would be a rare college which would seek to deny students their ever-increasing lack of responsibility towards themselves. How indeed could they be democratic institutions if they rejected the wills of their constituents? They are doing nothing but following the wills of those who they serve! To say nothing of their parents, who desire their children to have all the Best, the Fun, the Ease – all that money can buy – they are simply serving that which is desired they serve!

This would at least be true if not for the fact that colleges are supposed to be responsible for the education of their students.

Instead they create a system whereby self-responsibility can be reliably and consistently flaunted by all who dwell within and support it.

Students are punished who take advantage of a situation, yet those who create that situation in themselves are defended. The situation is equal for both parties in the sexual congress. The parties are for all purposes identical; they are the same. The sole factor which separates them is that one is the passive partner, and one the active. The college protects the former and decries the latter. There could be no clearer explication of the college's opinions concerning the ethics of the behaviors in question, nor of the ethical principles which guide academia anon.

Autointoxicatory behavior is not much tenable in a collegiate environment. It leads, in short, to rape. Rape as it is defined by the college is guaranteed to occur when the people who leave themselves open to rape are protected in the very behavior which leaves them so vulnerable. Rape is guaranteed to occur when the only way students are discouraged from undertaking it is in through a fear of punishment; not a desire to behave better, nor a wish to protect the unfortunate, for how rarely would the subject of their affections be worthy of sympathy? Is not the very behavior which allows them to be taken advantage of, likewise the very behavior which removes from them any sympathy, does all but cast the light of condoning, of acquiescence, upon the actions of their assailants?

One might as well attempt to cure a society of its desire for drugs by making them illegal. One might as well try to cure nature of its abhorrence of a vacuum by handing out free oxygen tanks – with an associated increase in tuition fees.[12]

However untenable it is in a collegiate environment, the true danger of such behavior is to be found when those who have practiced it move on to the world at large. These people will no longer be coddled by the laws of Club College; they shall be governed by the laws of real life, which are stricter, harsher, and more demanding of individual self-responsibility.

From this situation there result four sorts of individuals, two of the passives, two of the actives. There are those who refrain from taking advantage of those who have made themselves unable to give proper consent; theirs may be the kingdom of Heaven and the glory of god, one day, but for the nonce they are twice damned; they are forced to police themselves at every turn, resisting temptation which does not, absolutely, need be resisted; and they are, at its coldest, denied the gratification which they less morally inclined peers are given free access unto. Then of course there is the second group, who in so indulging themselves risk perhaps the law, and more likely the resentment of community – but freed from a college's protection, its far from invisible hand, can suddenly practice that which they were prevented from practicing in college only through fear of reprimand. They are suddenly given full license to indulge their fleshy whims. For what once was rape is now simply undignified; an indulgence with the incoherent, hardly gentlemanly, but in many if not most instances, nothing less.

And what of the people on the other side of things? The victims, so to speak, of unwanted attentions? Immediately upon graduation they shall have a clear choice to them. They can either continue in their current behavior, or they can change their ways. If they continue they shall no longer be protected from the undesired attentions of the desirous and attentive. They shall, in short, by the lights they have been given, be raped with vastly increased frequency. Else they can adapt to this new situation, modifying their behavior so that they are not ceaselessly the subject of sexual molestation. They can drink responsibly. They can drink with protection.[13] They can pursue their hedonisms safely. They can, in short, through moderation or restraint, abstain.

When considering motivations for such sybaritic behavior amongst college students, the benefits of an abstemious lifestyle might be seen as a directly causal variable. Challenge in life results from the distance between a per-

12 Would that fall under "student life?" I hear the SAF needs more money... –*ed.*

13 For those who haven't been paying attention up to this point, this does not, in fact, entail putting a condom on a pint glass. –*ed.*

son's abilities and the difficulty of a task at hand; Mozart likely had less challenge in composing a symphony than an agoraphobe has in bringing in the newspaper. Sobriety requires that a person meet all obstacles directly, whereas intoxication vastly reduces a person's abilities, making all tasks suddenly more challenging to complete. In a situation where no other challenge is presented, intoxication provides such and provides it in spades. Understanding even the risks for sexual exploitation, many choose to run these risks; for a lack of greater risks to run, to say nothing of risks which promise greater reward, is seen by them to be preferable to sobriety, easy, disinteresting, uneducational, and dull.

Given that an educational institution exists to prepare its attendees for life in the real world, ought it to be the policy of such institutions to provide sufficient challenge that such indulgence be, not only untenable, but undesirable?

Yet if this is not so: what then for our merry liberal artists? Given that real life, the real world its dwelling-place, shall of necessity succeed college, ought it not to be the policy of these young people to act in such a way that they shall be prepared for their graduation? No, sir, I see no reason that it should be so. When one is in Rome one behaves Roman; when one is in cold climates one wears warm clothing;[14] when one can drink without regard, one wastes the time their regards might have demanded upon better, things, or at least things more valued. To ask students to voluntarily abstain from taking full advantage of the pleasures and safeties afforded them is not just wishful, but impractical; to ask them to do anything but adapt to a situation, however dangerous that adaption, is to mistake the nature of the human animal.

Doubly so the animal which is the modern college student! It is our very task in life, our nature bred throughout, to adapt to new situations, to master them as quickly and as well as we are able. We are forced to pass through a series of examinations and tests in order to have secured our place at the institutions which we come to inhabit; they are artificial obstacles, it is true, but their effect is no different from the 'natural' obstacles, found in the chaos of the world-at-large, which produces the effects known as the survival of the fittest: adaptation.

College is known to be a safe place. It is known that it is the goal of the student to adapt to it; the student has, by these methods, been bred to adapt to it, been selected for its ability to adapt, been chosen for it is thought likely to adapt better than any of its competition. For a student not, then, to modify its behavior, as regards its sexual exploits and binging behavior, is not simply ludicrous; it is specifically against the expectations of college. For a student to succeed at one would be, of absolute necessity, to fail at the other. They are mutually exclusive.[15]

Thus is it not the necessary role of American colleges to modify their environmental education to suit the needs of the world beyond its walls?

To give students leave to drink with impunity, and learn that this is acceptable and without detriment to themselves, is as ineffectual as forcing them to forsake all languages in favor of Latin, as was once practiced universally, and solely because it was practiced universally. The situation is no different. The flavor of elitist absurdity has changed; the practice, substantively, has not.

It is within the College's power to change its behavior. It is within the power of the College to alter its definition of rape to include violent sexual assault, but not to include the lackluster scruples of beered-up frat boys and sorority girls. To conflate the terms is more than simply of insult to those who have been the victims of unpardonable crimes; it is to weaken the definition of rape, thus insuring that such crimes more frequently occur.

Surely it should not be encouraged that students take advantage of each other to the fullest. I am as much a free-market capitalist as the next man, but that would have the next man be moving past Milton Freidman and into Ernst Haeckel. A punishment ought to exist for those who so take advantage of their fellow students. But punishments must fit crimes; and to call drunken debauchery a crime of the same order as sober and methodical sexual assault is to equate murder with face-slapping, or to extend the death penalty to cover barfights; it is to make a gallows and call it peace.

Else, as the punishment for the two crimes is equal, it shall naturally fall between the just punishment for either, were they to be separate. As such you will undoubtedly find a slight decrease in the occurrence of the lesser crime, but an increase, probably greater, in the occurrence of the crime more terrible. It would have to be a profound imbalance in the frequency alteration, and going in the other way as well, for this matter to even be considerable from a coldly pragmatic perspective. As it stands, the logic favors nobody – excepting perhaps the college student, their charmed life, and their drinking.

It is the responsibility of a College to prepare its students for real life. It does not have to be real life itself. Much can be learned from tilting at windmills, much that

14 Not at this school they don't. Wait, maybe that's just Niko and Adam Krellenstein. Shit. –*ed.*

15 At this point in my reading, the author started playing Girl Talk. It was awfully related. –*ed.*

will be of great use when giants and dragons are by the jouster eventually encountered. Things must be kept safe for the student; if the windmills are to great, tilting at them shall teach nothing. But things cannot be made too safe; if the student is able to best the windmill, and easily, their play at jousting shall prepare them not at all for the monsters of the world. A balance must be struck. And at the moment, the balance is in favor of the monsters. And these monsters are doubly dangerous creatures, for they are not monsterous of appearance, but have the aspect of humans.

It is the responsibility of the institutions of higher education in America to alter their appreciation of undergraduate sexual ethics. They must, first and foremost, provide students with the ethical education whereby they will be disinclined to take advantage of a drunken classmate's tempting form, likewise be disinclined to become so incapacitated themselves. Secondly, and no less importantly, they must provide the student challenge, and the opportunity to beneficially challenge themselves, so that they shall have less time, and less prioritized inclination, to spend the coin of their time on this earth with such abandon and frivolity. Thirdly it must cease to provide such protection as it does for those who so poorly behave, in part by ceasing to punish those who take advantage of a self-imposed situation as harshly as those who impose that situation on others against their will.

It is a harsh alteration. It is not soft nor cuddly; it shall invariably lessen the fun to which a college student might abandon themselves. Yet it is unkind to the student, a thousand times unkind, to coddle them in their time of education. To leave things as they now are is for a modern College to continue to be responsible for the drunken stupidity of those who it means to educate – and to continue to be responsible for the sexual violation of those who have adapted to its education only too well.

On the alot (see p. 11).

submitted by Ian McEwen

http://hyperboleandahalf.blogspot.com/2010/04/alot-is-better-than-you-at-everything.html

Hampshire: A Hipstery.

by Alex Wenchel

Three weeks ago The Huffington Post published a tongue-in-cheek article decorating us with the imponderable accolade of being the land of the hipster, where irony comes to thrive and social justice comes to, I don't know, exist in an academic sense. What a glorious honor it is. Even Ralph Hexter took the time to write a response (a response that was as sarcastic as the article itself) that brought a smile to my face, but upon several hours of half-hearted retrospection has left a sour tingle on my mouth hole's taste nubs.

Ralph never disproved their contention, a fact that left me with sadness in my heart and ala Ke$ha, a serious lack of love in my glove box. When did Hampshire become known, not as the stoner school, but as a hipster haven? The students haven't changed, but sadly, our image apparently has.

I enjoyed the days when Hampshire was identified by our pot leaf sweatshirt rather than plaid scarves and skinny jeans. Don't get me wrong, I love the fact that friends' Facebook albums might be more at home on latfh.com but I wish other people hadn't realized it. It's an inside joke that was fun when it was just us, but now that the world knows, I think its time we brought back the part of the school that was openly hippy. And nothing says hippy like rallies full of mary-jane.

Being one who has never partaken of cannabis, I certainly don't condone the use of the somewhat illegal substance, but seeing as it happens here every day, I feel like we dropped the ball on 420. While we were mulling about not doing much, the University of Colorado was busy holding a 10,000-person smoke-out. To my knowledge it had no political import or message but at least it made the news, which is more than I can say for Hampshire.

I hope that next year we can do better, and maybe be recognized not just as a hipster school but as a hippy school, if for no other reason than to get Ralph to write a letter to The Huffington Post about how we are totally not high all the time and stuff.

SECTION **SPEAK**

Origin of Basalt Fire-Fountain Eruptions on Earth versus the Moon.

by Kristian Brevik

Rutherford and Papale (2009) compare the volcanic activity of a specific type of eruption, the fire-fountain eruption, between the Earth and the Moon. This comparison sheds light onto the differences of composition between the Earth and the Moon and the way in which similar processes work differently on the two bodies. On Earth, fire-fountain eruptions eject basalt violently, and are driven by the exsolution of CO_2, where the CO_2 leaves magma and expands, forcing the magma onto the surface violently, as a "fire-fountain". This is the type of eruption common in the Hawaiian islands. During the eruption, as the magma rises to the surface, CO_2, as well as H_2O and SO_2, are released, causing the violent eruption. On the Moon, it appears that fire-fountain type eruptions also occur, though the pressures, composition of the magma, and gases released appear to be different. As Shearer (2006) states, "questions remain as to the origin of these volatiles, the nature of the forces driving fire fountains, and the extent of degassing and volatile loss." This paper is an attempt to answer some of those questions.

When a fire-fountain eruption occurs, bubbles in the magma pop on the surface, flinging little bits of molten glass all over. These bits of glass solidify, preserving the surrounding gases in their outer layer. Analyzing these olivine-rich glass beads sampled from the lunar surface during Apollo, the authors can describe how the volatile gases involved in lunar fire-fountain eruptions differ from those on Earth. These glass beads were almost certainly the product of volcanic behavior. The other possible way for glass to be created on the lunar surface is though high-speed impacts. However, while glass is very often present at the center of a crater and within the ejecta surrounding the crater, the glass beads found all over the Moon are likely not created by impact (Buettner and LeMone 1969) because if they were the product of impact they would likely contain fragments of the impactor. Using the composition of the glass beads, the authors claim that they are able to determine the different gases that are involved in lunar fire-fountain eruptions, how those gases are formed, and how the eruptions themselves differ between the Earth and the Moon.

The authors hypothesize that in lew of the variety of gases extant in terrestrial fire-fountain eruptions, it is primarily the oxidation of graphite (C) to CO gas that has the strongest effect in lunar fire-fountains. This is because the gas that is the primary driver on earth, CO_2, is not present in high quantities on the Moon. It appears as though this graphite is oxidized at depth, and as it rises, causes other volatile compounds to exit the solution, become gaseous, and contribute to the fire-fountaining. A 'side effect' of this graphite oxidation would be the oxidation of ferric iron to, eventually, just straight old Fe-metal. This Fe-metal should be somewhere on the Moon then, if fire-fountain eruptions were as common as the presence of glass beads seems to show. The authors speculate that the Fe-metal-rich material found in lunar highland rocks was at least partly produced by this oxidation of graphite in the magma of the Moon long past.

Although lunar gravity is one-sixth that of Earth's gravity, pressure on the lunar surface is extremely lacking, and though the composition of the lunar magma and gas are very different from that on Earth, the authors show in a series of figures that the dynamics of fire-fountain eruptions are extremely similar on the Moon and the Earth. Why is it then that we see so many tiny glass beads on the Moon? Because there are a number of factors than tend to be different from those on Earth, though not extremely so. First, the viscosity of the lunar magma is much lower than terrestrial magma, which when combined with the absence of pressure on the lunar surface, allowed for larger bubbles with thinner walls in the magma. When these

bubbles popped, the beads produced were much smaller than those found on Earth.

This paper does a fairly reasonable job of explaining the differences between fire-fountain eruptions on the Earth and those on the Moon. At least, I think it is a good explanation - I would need to be a vulcanologist to know. The largest flaw in the paper is the lack of a clear thesis or point-making statement. There is a large amount of numbers and data and jargon, which I imagine would make sense if I had a better idea of what the authors were trying to say. After reading the article several times, I was able to glean enough out of it to determine some of the differences they wanted to discuss. However, it is surely unfortunate that these points were lost in a veritable eruption of only slightly helpful surrounding sentences. If I could change one thing about this paper, I would have the authors add a small section discussing the significance of their findings to the rest of lunar geology. This would both put the paper in context and provide a constant thread through the paper.

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course

APPLY, MOTHERFUCKERS.

HAMPEDIA.

by Ian McEwen

Dear Ms. So-and-so.

by Rachel Ithen

Dear Ms. So-and-so,

I apologize for not knowing your last name. Its final letters are sprawled across your old ticket stub, but the first few just happened to be printed on the other side of the perforation. It could be Hoshinsky, Noshinsky, etc. I suppose I will never know. I do know, however, that your first name just so happens to be Deborah. And no, this is not creepy, especially when you messily leave half of your airline boarding pass in an old Vonnegut novel and then sell it on the internet.

I found the ticket stub when I skimmed through my newly purchased copy of Cat's Cradle to make sure the seller on Amazon.com didn't make a mistake when labeling the book as being in "Very Good" condition. I must admit, the quality of the pages and the cover was worse than expected, but when you buy a used book for only a couple of dollars it's hard to complain.

As I was glancing through the pages, your ticket stub happened to fall out. The information I can retrieve from the boarding pass is as follows:

Your first name: Deborah
Your last name: --oshinsky
Your departure location: Amsterdam
Your arrival location: Boston
Your gate: 07?
Your boarding time: 12:30
Your departure time: 14:00
The date: September 16th, unknown year
Your seat: 36B
Your flight number: 0037

I am not entirely sure why knowing this information about a complete stranger amuses me, but it does. The instant I read the boarding pass (or what was left of it) I immediately found myself creating stories about your life story.

Perhaps you were on your way home from a vacation that was filled with awkward prostitutes standing in large windows and a visit to a museum devoted to the history of marijuana. (No, I did not go on a family vacation to Amsterdam and see both of these things for myself before I was ten years old. You're crazy.) Or perhaps you lived in Amsterdam and thought an exotic trip location would be the home of the Red Sox.

What intrigues me the most is that I have no idea what year this travel took place in. The boarding pass looks pretty worn down, so I wouldn't doubt that it happened more than ten years ago. Maybe you were visiting family in Massachusetts, or maybe you met someone on the Internet that you were willing to spend money on to meet in person. Or maybe the Internet didn't even exist yet. Who knows?

I imagine you could have been a young woman under the age of twenty-five. You and your boyfriend, both from Connecticut, decided to run away together and elope in an exotic location far away from the disapproving stares of your parents. You saved money for months, doing odd jobs for your neighbors and peers at school, until you finally had enough for two one-way tickets to Amsterdam. You imagined that leaving would offer you a fresh start to life, and one which you would get to spend solely with the one person you wanted to spend it with. You imagined that finding simple, well-paying jobs would be easy to do and that you and your boyfriend would be able to grow up together there, start a family, and never have to think back to your old lives in Connecticut. After a few days, you realized it was much harder than you imagined. You were happy to discover, though, that many more people there spoke English that you originally believed. But the only words you heard in English were the ones you despised hearing the most. "No, you're too young to work here." "No, you don't have the proper experience." No one would let you work there, even when you promised it would only be for a few weeks. After a week, your boyfriend started becoming more and more anxious. As time went on, you quarreled as though you were already married. Your search for quick cash was failing and –

In any case, you have a good taste in novels.

Signed,

Rachel (AKA Creepy McCreeper AKA The One Who Overanalyzes Ticket Stubs AKA HAPPY LAST OMEN ISSUE OF THE YEAR!)

The Lunar Environment, Dr. Wendell Mendell, and Future Scientific Exploration of the Moon, Dr. Paul Spudis.

by Kristian Brevik

The pairing of these two lectures provides a strong foundation of the environmental conditions on the Moon, the data we might want from the Moon, and the way in which we would need to interact with the environment to get the data that we need. Dr. Spudis focuses his talk on why we want to go back to the Moon. He answers range from learning how to explore best, how to live and work off planet, and as a stepping stone to further exploration and colonization. He focuses on the ways in which we can explore the Moon, emplace ourselves there, and maintain our presence though repairing and restocking outposts. Apollo was not long enough, complicated enough, or diverse enough to find out what we need to do long-term situations. While the Apollo missions could just discard or jury-rig broken equipment, we will need to fix things. We know some about the lunar environment, but we need to go back and get more data - something both Dr. Mendell and Dr. Spudis agree on.

Dr. Spudis begins by exploring more philosophical ideas surrounding lunar exploration. He says that exploration is not the same as science, but it enables science. Exploration is broader and richer than science, and people have a number of reasons for undertaking it. Why should we send people instead of just robots, he asks? Because people have cognitive abilities and can adapt to new situations. Also, humans have 'inspiration, drama, and spectacle' on their side, which is important, especially in terms of getting the public interested.

Dr. Spudis describes two different types of lunar mission, the Apollo-style sortie mission and the outpost mission. Sortie missions will likely be the first missions we make, and are good for obtaining data from a large number of diverse sites so we can have a good overview of geology, and perhaps select the best possible site for a longer term mission. However, on each sortie mission, we are forced to leave a bunch of equipment and supplies behind, which is a big financial loss. What we would want to do eventually is work up to outpost missions. These outpost missions would, rather than discarding equipment, build up capabilities, help us figure out how to live on the Moon, and provide a staging ground for more sortie missions, in essence giving us access to the whole planet. In most field geology, one collects rocks, analyzes them, then goes back for more. It is an iterative process - we didn't get to do this with Apollo, since we could only go to each site once. Outposts would allow us the possibility of iterative exploration. These outposts can also provide the location for long-term data collecting establishments that may require some maintenance, such as observatories, and laboratories for geophysics, astrophysics, and heliophysics.

While Spudis discusses how awesome lunar exploration and its possibilities can be, Dr. Wendell's discussion of the lunar environment consists of basically a list (his term) of things, many of which pose a threat to lunar exploration. First of all, the Moon has no magnetic field to deflect Galactic Cosmic Rays, which can damage DNA and cause a number of other 'mortality risks'. Regular old solar radiation can also pose these dangers. These effects would likely not pose any danger on 'sortie missions', though Dr. Mendell does not discuss this directly. However, any longer term mission or outpost would require some form of shielding from the radiation. Luckily, shielding can be effective, especially shielding composed of a material containing abundant hydrogen, such as water or plastic.

Another danger that we can shelter from, if we have enough warning, are solar particle effects. While there is a constant flow of ions and magnetism that flow from the sun, the real danger comes from these events, which are large fluxes of very-high energy ions. These ions, unlike GCRs, can cause immediate death. These events tend to give very little warning of their occurrence, and can take less than half an hour to reach the Moon from the Sun, which gives very little time for astronauts to take shelter. For lunar colonization to take place, we need to be either able to predict these events or provide astronauts with a way to be alerted to take shelter when necessary.

Dr. Wendell also brings up the danger of meteoroid impacts, as well as ballistic ejecta from non-direct hits. While the vast majority of impacts are microscopic to submicroscopic, larger impacts do occur. Whatever shielding the outpost has will probably be sufficient to

guard against these small impactors. Larger impacts pose a larger risk, however, it is a "matter of probability" and it is highly unlikely that a large meteoroid impact would occur. Micrometeoroid gardening occurs when large numbers of impacts erode and fracture the regolith. For a sortie mission, this would not be a problem, but for long term establishments, we would need to look into how this constant erosion by micrometeoroids would effect structures and equipment.

The day-night cycle (lunation) of the Moon is, as you might expect, very different from that of Earth. day and night last about 15 Earth-days. Near the poles, you will have 6 months of daylight and 6 months of night. How will astronauts be able to see during long-term missions? One possibility, says Dr. Wendell, is earthshine. It might be enough, because it is at least 4 times that of moonshine on Earth. Dr. Spudis says, however, that earthshine is too dim for many of the low angles and nighttime work that astronauts would encounter. Especially at the poles, where many of the most interesting features may lie, we will need to produce artificial light somehow.

Dust - "the dreaded dust" - is of great interest to engineers and no interest to scientists, Dr. Wendell says. Dust can be inhaled, coat solar arrays and thermal control surfaces, get into mechanisms and electronics. This wasn't a problem with Apollo, but could have been if the missions were longer. Dust does not hang, but could be moved around by electric fields. Dr. Spudis says that dust is not necessarily as bad as we might think, and that we can deal with the potential risks. The reason the Apollo suits ended up so dirty was that they were not good for mobility, so the astronauts would bend down (and fall over) to pick thing up. I appears therefore that most of the dirt on the Apollo suits was deliberate, and if we have better suits and if we worry about them working for months, then they will likely less dirty. Also the dust is magnetic, so we could use that to get the suits clean, especially if we have an outpost style mission.

Dr. Wendell touches on a number of other possible issues with lunar exploration and colonization, most of which would effect the construction of equipment and habitation for astronauts. The low (about 1/6th of Earth) gravity will need to be taken into account when designing ceilings, stairs, and scientific equipment. The upper millimeter of the regolith is very porous, which makes for high retro-reflection of light, which like snow-blindness, needs to be taken into account for working on the surface and taking heat measurements. The Moon has a low thermal inertia, which means the surface temperature changes fast. However, rocks can capture during the day and slowly radiate it at night. Most of this temperature change in in the upper few millimeters of regolith, as solar radiation does not change the temperature even just a meter below the surface. Seismic events are not a big concern, since movement would be at the nanometer scale.

There are a number of hazards that we would need to think about when we are on the Moon. Dr. Spudis shows, however, that some of the hazards can be lessened buy the use of robots. Robots are useful for many things, such as paving the way for later human exploration, making sure things are safe, and making sure that equipment will work in extreme environments, but they cannot think or adapt during exploration. On missions where we want to be able to think or adapt, a human explorer might be a better choice. Human and robots working together might be the most powerful team we could have on the Moon.

submitted by David Axel Oxensteirna Kurtz and ...

Community Review Board Decision History

(September 1992 - April 2010)

Statement of Charges	CRB Findings	CRB Recommended Sanctions to Dean of Students
Had a disconnected smoke detector, appeal of house-levied sanctions	Findings not contested by appealant (only sanction appealed)	House sanction upheld: $300 fine and house probation
Covered smoke detector, appeal of house-levied sanctions	Findings not contested by appealant (only sanction appealed)	House sanction altered: Unable to participate in lottery, housing probation extended by one semester
Covered smoke detector, appeal of house-levied sanctions	Findings not contested by appealant (only sanction appealed)	Not enough information to make determination, no reccomendation made.
Covered smoke detector, appeal of house-levied sanctions	Findings not contested by appealant (only sanction appealed)	House sanction altered: fined $150 plus 15 hours of community service (10 hours of grounds work, 5 hours assisting with fundraising phonathon)
Violated right of business integrity by misusing student activities funds	Dean's hearing, found responsible	Disciplinary probation through end of next semester, must research and prepare written recommendations for controls to be put on student activities fee money to better ensure proper use for other students in the future.
Threatening and intimidating behavior	Found responsible	No communication agreement,two semesters disciplinary probation
Unregistered party, appeal of house-levied sanctions	Dean's hearing, findings not contested by appealant (only sanction appealed)	House sanction upheld: 10 hours of community service to be completed prior to commencement
Possession of illegal drug paraphernalia, distribution of illegal substances, physical endangerment, violation of alcohol policy, tampering with fire safety equipment.	Found responsible on all counts	Suspension, eligible to reapply after spring 2009
Sexual Assault, intimidating/physically endangering behavior	Not responsible on assault, responsible on threatening/intimidating behavior	"No Communication Agreement," participation in Men's Resource Center program, counseling, disciplinary probation (2 semesters)
Violated freedom of communication of ideas, right of integrity, right of personal security, discriminatory harrassment	Lack of evidence to sustain charges	No sanctions given
Violated code of ethics for computer user	Violated community norms	One semester suspension, followed by one semester on probation. Write letters of apology to Amherst College and Hampshire College communities.
Threatening and intimidating behavior	Violated community norms	One semester probation. Written apology sent to complainant
Physically endangering behavior, vandalism, damage to property, threatening and intimidating behavior	Not heard by CRB; untimely submission of the complaint	Not applicable.

... Daniel Patrice Lumumba Leigh Eareckson

Statement of Charges	CRB Findings	CRB Recommended Sanctions to Dean of Students
Lack of respect for people, noise, threatening and intimidating behavior, vandalism, damage to property, physically endangering behavior	Violated community norms	Two semesters of suspension, followed by two semesters of probation. Participation in drug and alcohol program required as prerequisite for readmission.
Vandalism, damage to property, theft, threatening and intimidating behavior	Violated vandalism, damage to property, theft only	Probation extended through AY and further violation of norms will result in suspension. Banned from dining commons remainder of AY. Complete 3 hours of community service per week for remainder of AY.
Physically endangering behavior, vandalism, damage to property	No violation against community norms	Not applicable.
Physically endangering behavior, vandalism, damage to property, theft	In violation of vandalism, damage to property, theft only	Community service.
Noise, physically endangering behavior	Not heard by CRB; insufficientattempts at earlier resolution through proper channels	Not applicable.
Physically endangering behavior, threatening and intimidating behavior	Violated threatening and intimating behavior only	Disciplinary probation for one semester. No physical/verbal contact with complainant
Physically endangering behavior, damage to property	In violation of physically endangering behavior only	Letter of apology to Physical Plant; ten hours of communication service.
Threatening and intimidating behavior	Violated threatening and intimidating behavior-- psychological intimidating and harassment	Suspension for two semesters, followedby two semesters on probation. Participation in psychological treatment program required as prerequisite for readmission.
Lack of respect for property; acts of vandalism	Acts of vandalism to students' property	Apology to two students involved. One student received one term of probation; second student received disciplinary warning.
Physically endangering behavior; threatening and intimidating behavior	Violated community norms	Dean's disciplinary warning. Must seek an assessment of alcohol use. Must seek counseling for issues of aggression
Threatening and intimidating behavior	Not heard by CRB; insufficient evidence	Not applicable
Physically endangering behavior; threatening and intimidating behavior	Violated norms of community living	Accompany public safety officers on8 hours of shifts, at discretion of director of public safety
Physically endangering behavior	Violated norms of community living	May no longer live on campus; disciplinary probation until end of Hampshire education; service hours; formal letter of apology community to Hampshire community
Sexual harassment	Violated norms of community living	Must provide official apology to complainant

Hagermann and Tanaka 2006, Ejecta deposit thickness, heat flow, and a critical ambiguity on the Moon.

by Kristian Brevik

I have to say that reading this paper was like jumping into the middle of a highly technical conversation about a topic that I have little background in. It wasn't so much that I didn't know the terms (which I could look up), but that it took me much longer to get into the jive of the lingo than I have been able to do with previous papers. From the very first sentence "..values of 21 and 16 mW m^{-2} ..., my interpretation of the paper had to be based on the assumption that the heat flow measurement values indicated heat lost by the planet into space. Neither this paper, nor Hagermann's review (2005) ever say in which direction the heat is flowing, they simply provide the values. With this assumption in mind, Hagermann and Tanaka discuss the measurements of heat flow taken during the Apollo missions and show that their validity is questionable.

The primary criticism, referred to as a "critical source of ambiguity", is the distribution of thorium in the near-surface regolith of the Moon. Hagermann, in his 2005 paper, lists the ways in which heat can flow out of a planet and its sources, these being: energy retained from the accretion of the planet, energy created as different components of the planet separate out into layers, heat created when radioactive elements decay, heat created by crystallization, heat created by electric current, and dissipation of rotational and orbital energy. Additionally in this paper, Hagermann states that the primary mode of heat production on the Moon is through the decay of radioactive elements, which make things less complicated and provides less variable to account for. However, the data we have from the Moon from the Apollo missions, he states in this 2006 paper, is flawed.

The data on heat flow we have from the Moon comes from the Apollo 15 and 17 missions at two locations, Hadley Rille, a channel-like depression , and Taurus Littrow, a narrow valley. Both missions were located in close proximity to the Mare Imbruim, thought to have been created by the 'Imbrium impact'. On both missions, the astronauts were to place probes 3m below the surface to measure heat flow. Unfortunately, the probes were not placed deep enough due to technical difficulties, and the very construction of the probes was not ideal for the measurements taken. So to start off, the authors call into question the very data.

Since this data was taken, there have been a number of analyses, each 'correcting' the previous analysis. First, soon after the data was taken, Langseth (1972) estimated the heat flow as 33 mW m^{-2}, though these results were soon revised to 21 mW m^{-2} at Hadley Rille and 33 mW m-2 at Taurus Littrow (Langseth 1976). In two papers, one in 1985 and one in 1987, Warren and Rasmussen stated that these results were not valid, since the measurements were taken so close to the mare/highlands boundary. After correcting for this, they obtained a result of 12 mW m^{-2}. In 2003, Saito et al. named a number of other variables that need to be taken into account in analysis of this 37 year-old data, and later in 2006, Wieczorek and Huang named even more important factors.

What this paper adds to the discussion is that the nature of the regolith, since it is so close to the Imbrium impact location, needs to be taken into account, especially with regards to the amount of thorium, a radioactive

(and therefore heat-generating) element. Since the locations are so close to the impact crater, the authors state that the experiments took place within ejecta from the crater, which would have significantly different thorium concentrations than the surrounding regolith, and also from each other, as it is assumed that the thorium levels would decrease the farther one was from the impact crater. The two Apollo sites, being located at different distances from the impact crater, should have different levels of ejecta, and therefore different concentrations of thorium. This thorium in the ejecta layer could perhaps contribute a significant amount to the overall heat flow, and since the difference in ejecta depth and therefore heat contribution could be huge between the two sites, it is difficult to discern an average heat flow for the Moon as a whole from just those two data points.

If it is the case that the thorium abundance of the ejecta does not change with depth, than it could be that only the depth of ejecta differs between the two sites. The authors show that even if thorium concentrations were constant, than the difference in heat flow measurements from the two sites could be accounted for just by the difference in depth of the ejecta layer. This is simply due to the greater amount of thorium piled up in the thicker layer. This thorium, based solely on depth of ejecta, could, the authors claim, drown out any other differences in heat flow between the two layers, making the results less valid than they would be had the measurements been taken at more locations on the Moon.

The main point of this paper, it seems, is to show that the Apollo experiments on heat flow were useful, but are not terribly accurate. The differences in heat flow between the two locations, Hadley Rille and Taurus Littrow, could be explained in several ways that do not contribute fully to our knowledge of average lunar heat flow. The differences could be the result of variable amounts of thorium in the regolith at the two sites, or of different depths of thorium-rich regolith at the two sites. Both of these issues are related to the fact that both sites were located fairly close to the Mare Imbrium, the result of the Imbrium impact. In order to obtain more thorough data on lunar heat-flow, the authors urge more missions with probes placed all around the surface of the Moon. This appears to be in the works, as the LunarEX mission (Smith *et al.* 2009) plans to drop several penetrators to measure heat flow on the far side and poles of the Moon.

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If I had been named as graduation speaker, this is what I would have speaked.

by David Axel Kurtz

Good afternoon.

As you probably know
My name is David Axel Kurtz.

I mean, I recognize about nine out of ten of you.
And that's including parents and siblings.
So you probably know who I am.

And you probably know what I stand for.
So
if only in the interest of breaking type
I'll try to keep this brief

And I know nine out of ten of you
But to the ten percent I don't know

Who are you?
I've been coming here for four years
Haven't really left campus that often
Where have you been?

Did you forget to leave your rooms for four years?
Were you too good to come to Omen layout?

We ordered wings. Did you know we ordered wings?

Man, I'm going to be walking down the street in ten years
And I'm going to smell honey mustard
And I'm going to think, "Ahhh, the smell of Hampshire!"

That, or people smoking Cloves.
That was first year, at least.

Well, really the smell of anything being smoked.

Obligatory joke is... obligatory.

OK, maybe there were better things to do
for four hours on a Friday night
then lay out the Omen

I can't think of any offhand.

I've been trying for four years
Still can't think of anything
But they might exist, somewhere

And we've all done some pretty cool shit
In our time here

I mean, we kind of had to

What else was there to do?

You parents, you just threw our stuff
Into the back of your car
And then drove out here
To the middle of nowhere
And dropped us here
In the middle of a cornfield
All together

For four years

And said, "Go to college!"

And you didn't know what that means
And we didn't know what that meant
And NOBODY HERE knew what that meant

So we had to make it mean something.

And, you know
I think we did

And we may not have spent our time
As wisely as we could have

But we've all learned a thing or two
About how to spend our time

How to plan things

How to do things

Some really cool things, too

And that's not nothing

This isn't the first time I've given a graduation speech.
I was speaker at my high school graduation too.

Not exactly a big feat,
Since there were only 34 of us
And I was the only person who applied for the position

And a few days ago,
I was looking at what I read, then

And I was surprised
And really, kind of moved
By how much of it was still applicable
Here and now

Most of it is actually a lot more applicable
Now
Than it was then

And I think I'm going to tell you now
What I told them then

That four years has been, alas,
Far too short a time
To spend among such fine and admirable hobbits
Shire-folk
As yourselves

And I don't know ANY of you
Half as well as I should like

(With the exceptions of
The Omen,
The Blacksmith's Guild,
Circus,
The O Squared,
Non Satis,

And Mods 1, 33, 56, 71, and 92)

And I'm sure I like half of you
Less than half as well as you deserve

(Though I've been working on that
As I think some of you know)

But I do
Have things to do

I've put this off
For far too long

I regret to announce
That this is the end

I'm going now
I bid you all
A fond farewell

REACHES ABOVE HEAD WITH RING
PUTS ON RING

TRIES A COUPLE OF TIMES

Fucking eBay!

Can't get a good Ring of Power anymore!

OK, so I guess I gotta finish this speech now.

No, but we have

We have done some cool shit in our time here

And I have absolute faith
That most every one of us
Is going to go off
Into the world
And go on
Doing cool shit
Very cool shit

For a very long time

We certainly have the potential to do it
So we better do it.

That's what I think for myself, anway.

And so I'm going to say this,
I'm going to say this once:

KEEP
IN
TOUCH

We're about to go off into the world
Guess what?
The world's pretty small!
You know my name
You know where I am
You know where I live
You've got my cell

You've got my eMail

You can recognize my facial hair from a thousand miles away

KEEP
IN
TOUCH

You're going to be doing cool shit
I WANT TO KNOW ABOUT IT

Hell, give me a call
20 minutes before you start
I'll show up and help out

I mean
I think we all know
That I am pretty much unemployable

I'm gonna have a lot of free time on my hands

So when you're doing cool shit
CALL ME

You know I'll be there for you
if you need me

You know I'll be hanging around
Ready to hang out

I think you all know

That I'm the kind of guy

That I'll never give you up
That I'll never let you down
That I'll never run around
And hurt you

That I'll never make you cry
That I'll never say goodbye
That I'll never tell a lie
And desert you

Ha ha ha ha,
You have been rickroll'd

Anyway.

So let's see
I did the Bilbo quote
Pimped the Omen
Told you bastards to keep in touch
Did the One Ring joke
Rickroll'd

What else?

For Great Justice
Yeah, okay, there's that

Made some long, rambly-ass speech
About how Hampshire better remain true to it's mission
And true to itself
And keep being Hampshire
Or I'm gonna be PISSED

Well, I didn't make that speech

But you've all heard it before
So let's say just that I made it

And move on

I mean, that's basically the long and short of it
You've all heard it all before

I've had four years

And in four years
I've said
Just about everything I want to say

I've certainly tried to

And why not, right?

So what else?

Oh yeah, one more thing

I think you all know
That we have a very special person
Who's graduating this year
With us

Some of you love him
Some of you hate him

Some of you invited him in once
and then ended up living with him
for a few consecutive semesters

ALL OF YOU
have spent way too much time
talking about him

And all of you,
All of us,
Whether we like it or not
Are his people

So let me say to you now

In the words of Freddy

11 words
Which say
what I want to say
As well as it can be said

HAVE FUN
BE CAREFUL

I'll see you when I see you.

BLOW KISS

>END IF

Fluxes of Fast and Epithermal Neutrons from Lunar Prospector: Evidence for Water Ice at the Lunar Poles.

This paper decribes the possible detection of water ice on the Moon from data obtained by the Lunar Prospector mission in 1998. The Lunar Prospector (LP) orbited the Moon, measuring the rates at which fast, epithermal, and thermal neutrons were flowing. The rates detected by LP suggested that hydrogen was present in the regolith. This hydrogen, according to the authors, was contained in the form of water. However, later research suggests that the locations of the deposits suggested are not suitable for water ice, and that the hydrogen is possibly present in another form, making this line of research considerably less exciting, as least with relation to the possibility of future colonization of the Moon.

The authors expect that water on the Moon could have come from a number of places; from comets and asteroids, by the reduction of FeO by hydrogen in the solar wind into H_2O, and by the slow release of water from the lunar interior. However, water can also be lost due to meteoric bombardment, interference of interstellar hydrogen, and erosion. Earlier studies using Clementine data suggested that deposits of hydrogen in the form of water ice exist at the poles of the Moon, however, this study is an attempt to solidify the evidence for water on the Moon, using the techniques described below.

The names of the neutrons relevant to this study come from the amount of kinetic energy they posess. Fast neutrons are those neutrons that contain "greater than 1 eV (electron volt)," (Wikipedia), while epithermal neutrons have an energy from 0.025 to 1 eV. An electron volt is the amount of energy gained my a single unbound electron passing through an electrostatic potential difference of one volt. For the purposes of this paper, "fast neutrons are formed at high energies as the result of interactions between galactic cosmic rays and the nuclear constituents of the regolith." (Feldman 1998) As they are hit by cosmic rays, they transfer energy to neutrons in the regolith, creating a flow of epithermal neutrons. This then result into an increase in thermal neutrons, until they reach equilibrium by loss to space and absorption. The way this information can be used to detect water on the Moon is that it is expected that hydrogen atoms would cause the flux of fast and epithermal neutrons to decrease. Ar-

by Kristian Brevik

eas with a lower flux of epithermal neutrons "epithermal depressions", are, according to the authors, evidence of hydrogen in the form of water ice.

There are lower levels of epithermal flux intensity at the both poles of the Moon, especially in permanently shaded areas. These measurements are indicative of the presence of hydrogen in the form of water ice in these regions, though it be covered by up to 40 cm of regolith. These deposits occur mostly at the bottom of craters, however, as Margot 1999 suggests, the correlation between deposits found in this study and "cold trap" craters may be an imperfect one.

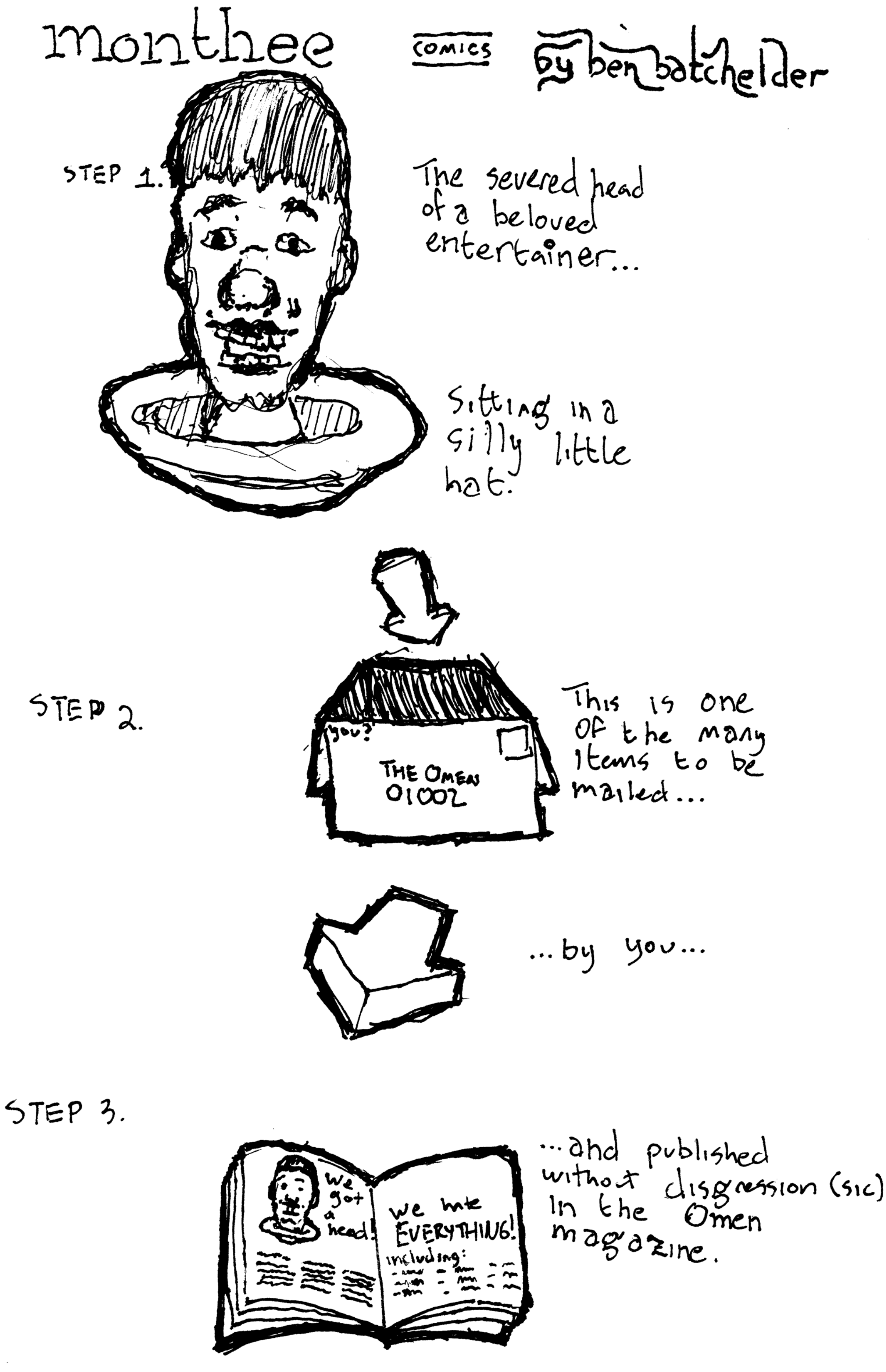
It is helpful that the authors devote a section of the paper to describing the actual sensor, its mechanisms and how it is constructed. Many papers as highly technical as this one omit the way in which the data was collected. This makes it more difficult to understand, since the mechanism of measurement can lend insight into the import of the data. In this case, the measurement of thermal and epithermal neutrons was take by two He filled gas counters, one of which could detect only epithermal neutrons. These two sensors were so calibrated so as to allow detection of the variable flux of thermal neutrons coming from the regolith of the Moon. Fast neutrons were detected by a gamma-ray spectrometer.

The first three figures of the paper give simulated data for what one would expect to find, taking into consideration different depths in the regolith and amount of H20 in the regolith. I would have expected later figures to have a similar layout as these first three. However, the correspondence of these three figures with the next four is lacking. Figure 5 was the most helpful figure in describing the results of the study. It shows two images of the globe of the Moon, with differently colored areas showing differences in number of epithermal neutrons. Higher densities occur at the poles, as well as in shaded craters. Figure 8 builds on this, showing a graded map of both poles of the Moon, with higher neutron flux in darker colors.

The authors conclude from the neutron flux data that in regions with depressed epithermal neutron flux, higher proportions of hydrogen are present in the regolith. One of the major flaws in this paper, as stated in a later paper by Feldman (2000) was that the lack of data from fast neutron flux prevented a measure of the amount of hydrogen in the polar deposits. Lacking this data, the deposits found by this research could have varied in an number of ways, including the depth of distribution and wether that distribution was present in layers or in clumps. Feldman (2000) also describes how the lowering of the orbit of Lunar Prospector has allowed for a greater resolution in more recent data, adding significantly to knowledge of the distribution of these deposits.

In the conclusions of the paper, the authors state that "if our interpretation" is correct, then the data they are reporting are consistant with buried deposits of water. However, the results could be very similar if changes in several variables, such as the distribution and density of water, different depth of the deposits, or the geology of the deposit, were combined. The authors go on to describe a large number of assumptions that are necessary to accept for their predictions to be correct, including depth of the hydrogen, time spent accumulating, and shaded surface area. Margot et al (1999), which describes the distribution of 'cold traps' on the lunar surface, suggests that some of the findings of this research are inconsistent with cold areas at the bottom of craters, and that thermal conditions may not be suitable for water ice at all the locations in which hydrogen was detected using the LP sensors. Since the higher density of cold traps at the southern pole should result in higher densities of water, Margot suggests that the hydrogen detected by LP may not be in the form of water.

Though the data collected are "consistent with models of buried water-ice deposits" within the regolith of the Moon, the paper does not provide a strong argument for why the hydrogen detected is in the form of water-ice rather than some other form of hydrogen. As later papers suggest, the hydrogen could likely be some form other than water. If this paper was describing a topic within a less high-stakes field than "water on the Moon", I might be less likely to suggest that the results were pushed towards suggesting something that in other circumstances might be less conclusive. This could be an example of how current excitement (and so dollars) can influence the way data are interpreted.


monthee
COMICS
by ben batchelder
STEP 1.
The severed head of a beloved entertainer...
Sitting in a silly little hat.
STEP 2.
you?
THE OMEN 01002
This is one of the many items to be mailed...
...by you...
STEP 3.
We got a head!
we hate EVERYTHING!
including:
...and published without disgression (sic) In the Omen magazine.

Lunar Mare Volcanism: Where Did the Magma Come From?

by Kristian Brevik

On a most basic level, Grove and Krawczynski et al (2009), discusses features of lunar samples and geophysical data associated with the formation and history of the magma of the Moon, and describes a few theories that attempt to explain all of these features. The paper also discusses many of the issues with these theories, and the questions that remain unanswered about the magmas and the process of their origin and subsequent formation.

Early analysis of the Apollo samples provided evidence that the Moon was once covered by a deep global magma ocean that soldified fractionally, with different minerals solidifying at different times. This differentition could explain the composition of the lunar highlands, which, since they are rich in plagioclase, could have been formed by the flotation and solidification of a plagioclase crust on the surface of the magma ocean. The ratio of certain rare earth elements in the material forming the mare basalts of the Moon is strong evidence that some of the elements (Europium) were 'used up' in earlier plagioclase crystallization.

The presence of glass beads on the surface of the Moon discovered during the Apollo missions added complexity to these theories. The beads were most likely formed by the ejection of super-heated magma into the cold lunar vacuum, where they were rapidly cooled. It was later found that these beads were almost ubiquitous in lunar soil samples. The beads were of varying color (and thus compostion) some of which are unknown on Earth. These compositional characteristics provide further evidence of prior chemical differentiation as certain materials cooled at different times.

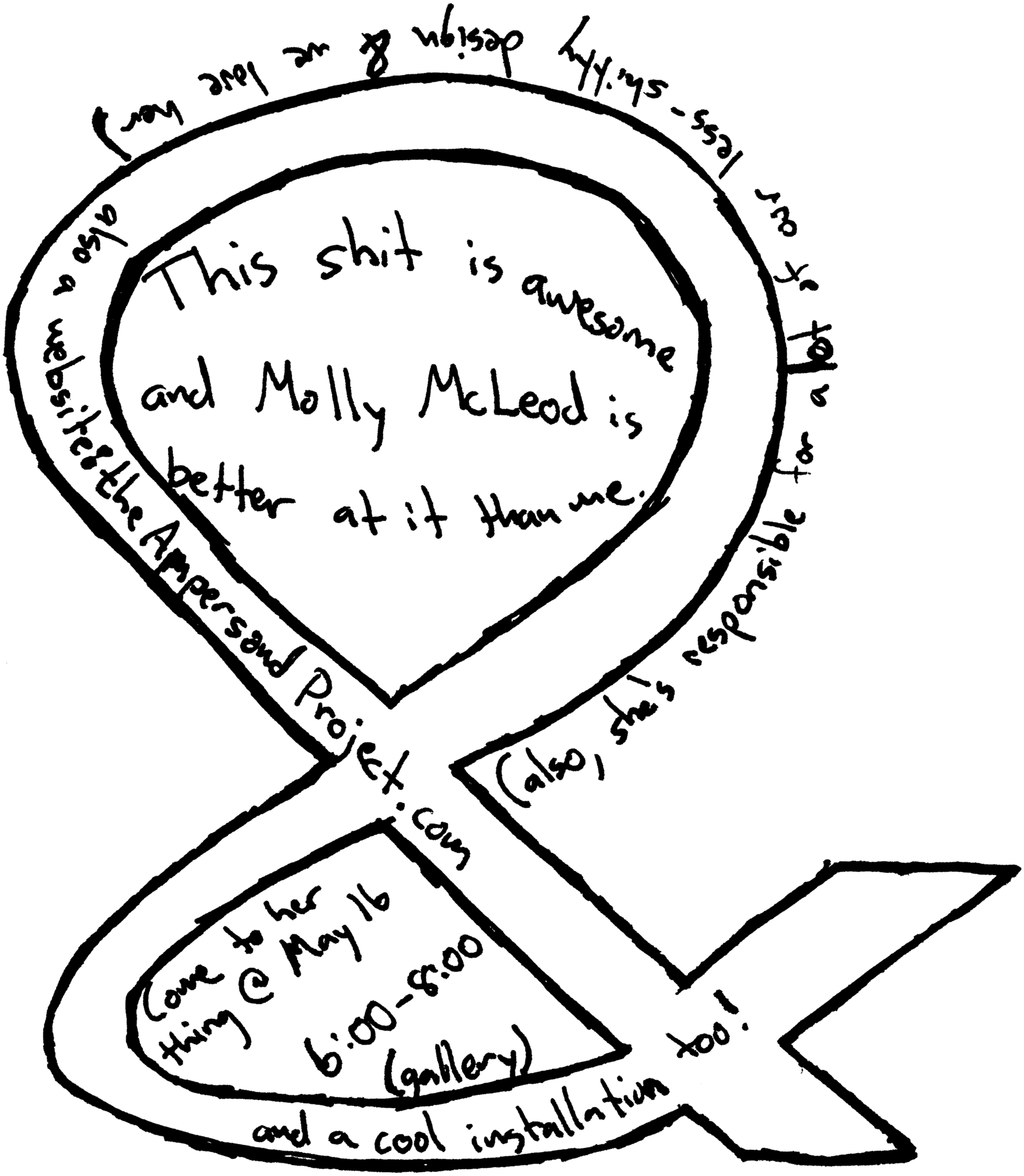
These beads, along with the variation and 'uniqueness' of the mare basalt, preserve evidence that the cooling of the lunar magma ocean happened at once, a process that differentiated the material that makes up the Moon. This results in a large variation in composition of the various basalts found in the maria, while the basalts found on Earth and Mars are comparatively uniform.

The paper describes the evolution of the theories that attempted to explain the formation of the Moon and the processes that resulted in those changes. One of the earlier theories holds that the material at the top and the bottom of the magma ocean crystallized first, changing the composition of the ocean as certain materials crystallized out. Then, when different sections were remelted (to form the maria, for example) at different times, depths, and temperatures, the composition of the various basalts that formed differed.

However, this theory did not explain the ultramafic glass beads found on the surface, which needed to have formed at a greater depth in the lunar ocean than the expected cooling rate of the ocean would have allowed. This brings up the necessity of a process later than the cooling of the ocean. One possibility would be the overturn of heavier regions on top of lighter regions sinking in and remelting material. The liquid ejected from this process could have created the glass beads. However, this theory ran into problems when it was discovered that the densities of the various materials involved would not have provided the necessary conditions for this to occur.

The authors finish up the paper by discussing avenues of further research. One questions they ask is where the heat necessary for these remeltings came from, since the height of volcanism on the Moon was half a billion years separated from the solidification of the magma ocean (though I don't know in which direction, the wording was unclear). The two leading hypotheses for this heat generation are either the tidal forces generated by Earth, or by meteorite bombardment. However, the authors do not discuss these theories in great detail, and so the plausibility of each theory remains a mystery. The extent of the initial melting of the magma ocean is also not resolved - mainly because the composition of the Moon is still unknown.

This paper provides a good introduction to the basic history and theories behind the formation of the lunar magma ocean and the reformation of magma necessary to create the ultramafic glass beads and the basalt of the maria. However, the paper is perhaps intended for geologists rather than a wider audience, as there were many terms that necessitate the use of the internet or a nearby geologist to decipher, and the significance of the various form of rock and mineral are not discussed.



by Ian McEwen

The Luna Missions.

by Kristian Brevik

The Luna missions comprised a series of unmanned robotic explorations of the Moon by the Soviet Union beginning in 1959 and ending in 1976. The missions accomplished a number of milestones and 'firsts' for not only Soviet lunar exploration, but for lunar exploration in general. The program included the first man-made object to reach the Moon, the first photos of the far side of the Moon, the first 'soft' landing on the Moon (and along with this, the first close-up photos of the Moon's surface), the first artificial satellite orbiting the Moon, the first rover on the Moon, and the first fully robotic sample return from the Moon. The Luna program included 24 missions, 15 of which were successful. However, there were over 40 missions that were originally intended to be a part of the Luna missions, but those that failed to reach space were not publicly acknowledged at all, while the ones that did successfully reach space but did not reach their intended goal of the Moon were rewritten as "Cosmos" instead of "Luna".

Launched in January 1959, Luna 1 missed the Moon by a considerable margin, it made the first measurements of the solar wind and became the first man-made object to enter orbit around the Sun. Shortly following Luna 1, Luna 2 was launched in September 1959. It confirmed the solar wind measurements made by Luna 1 and later crash-landed on the surface of the Moon, therefore becoming the first man-made object to reach the surface of the moon. The next month, in October 1959, Luna 3 was launched. This probe returned the first ever photos of the far side of the Moon. Luna 3 took 27 total photos of the far side, comprising 70% of the surface of the far side of the Moon. However, only 17 of the photos were successfully transmitted back to Earth.

After a series of failed attempts to land, in February 1966 Luna 9 made the first soft landing on the Moon's surface by any spacecraft. Once it landed, it sent nine photos (five of them panoramas) from the surface, which were the first photos sent from another planetary body. In addition, the successful soft landing of Luna 9 demonstrated that a heavy craft would not sink into the lunar dust. About a month later, in March 1966, Luna 10 became the first artificial satellite of the Moon.

Four years later, in September 1970, Luna 16 was the first fully automatic robotic sample return from the Moon, returning 101g of lunar soil. However, the Soviets were unable to claim fame to the first sample return, as Apollo 11 and 12 had managed to return samples prior to it. Amazingly, once the return stage of the probe lifted off the Moon, no course corrections were necessary for the probe to land in Kazakhstan 3 days later. (Note: We don't give the Soviets enough credit) Luna 20 and 24 also successfully returned samples from the Moon, 55g and 170g respectively, all robotically and unmanned. In total the sample return from the Luna missions was .326kg compared to Apollo 11 and 12 which collected 22 kg and 34 kg respectively.

In November 1970, Luna 17 landed on and delivered the first robotic rover to the Moon, Lunokhod 1. Lunokhod was 840kg, had eight wheels on independent suspension and had two speeds. For imaging the surface of the moon, Lunokhod had four TV cameras, three of them were panoramic cameras and one was a high resolution camera used mostly for navigation. Commands were able to be sent to the rover from Earth in real time. The rover was powered by solar panels, during the day and "hibernated" during the lunar nights - using a Polonium-210 heating system to keep the rover from freezing. Originally Lunokhod 1 was going to survey the lunar surface in the hope of choosing a site for a future manned mission. After the Americans succeeded in the manned moon race, the mission objective of Lunokhod was changed to simply exploring the lunar surface instead. Lunokhod took 20,000 TV images of the surface and over 200 panoramic high resolution photographs in addition to conducting several basic tests, including testing the ambient light for possible astronomical observations from the moon, measuring the local magnetic fields and testing the lunar soil. The rover was built to last for three lunar days (three earth months) but surpassed this expectation to last eleven lunar days.

In 1973, Luna 21 delivered a second rover, Lunokhod 2, to the Moon's surface. Lunokhod 2 was similarly designed as Lunokhod 1 and conducted similar research, taking over 80,000 TV images of the lunar surface but lasted only 4 earth months on the moon before the mission was concluded. It is believed that the rover accumulated dust in the body of the rover on the radiator and overheated. Unlike Lunokhod 1, the position of Lunokhod 2 is currently known and the rover along with Luna 21 was sold for $68,500 in December 1993 to Richard Garriott, a video game designer.

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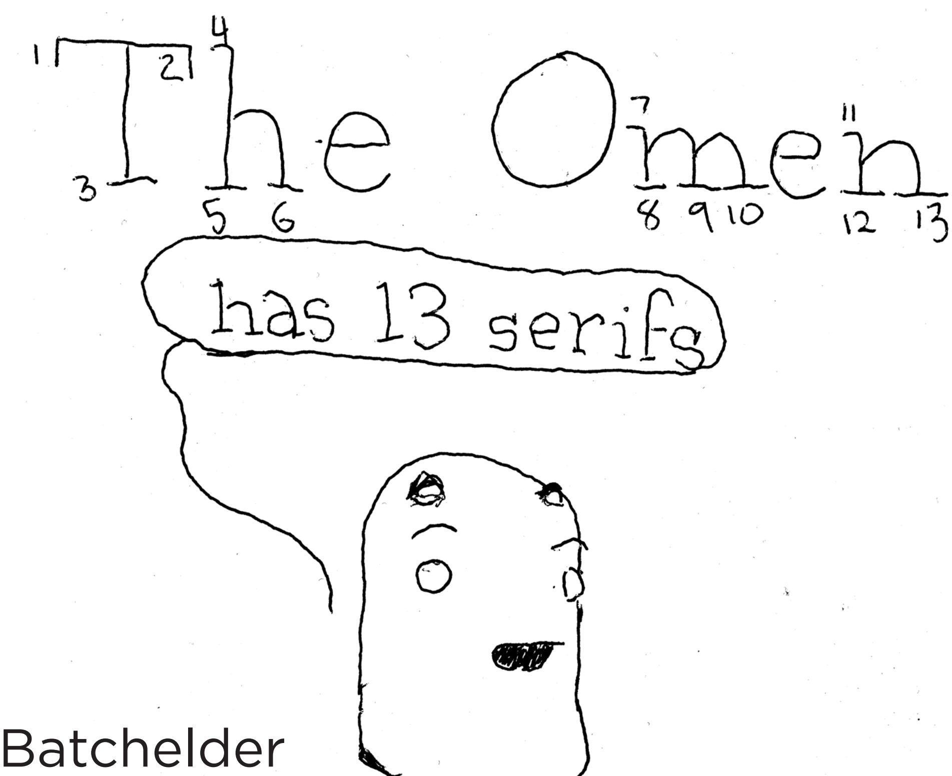

purportedly Ben Batchelder

The High Cost of Lunging.

by Kristian Brevik

Rorqual whales feed in a number of ways, one of which is known as lunge feeding, where the whale opens its mouth while underwater, allowing it to be filled with water and prey (krill in the case discussed). While this allows a whale to get a large amount of food in one gulp, the drag created by opening the mouth slows the whale down to a near stop. The whale then needs to accelerate again in order to continue feeding or return to the surface. This manner of start/stop feeding should be more energetically expensive than swimming and ram feeding at a constant rate, as some whales do. The authors of this study examined the feeding behavior of humpback whales and the respiratory costs associated with those behaviors.

We know that humpback whales lunge-feed, the question is whether this method of feeding incurs a higher energy cost and thus results in respiratory compensation upon the whale returning to the surface. These energy costs can only be measured indirectly (putting a mask on a whale would be an adventure), so the researchers measured the time a whale would remain on the surface after a feeding dive and the number of breaths a whale would take while on the surface. These numbers can then be compared to the surface-time and number of breaths taken by non-feeding whales, and the cost of lunge feeding can be inferred.

Whales were tagged in order to measure their depth, acceleration, and speed and also the occurance of lunging. Lunges were assumed to have occurred when the whale reached a speed maximum and then rapidly slowed down while remaining to swim forward, probably to compensate for the drag caused by opening its enormous parachute-like mouth. After the whale surfaced, its time from first to last breath was measured, as well as how many breaths it took. An echosounder was also used in order to determine at which densities of prey the whales were lunging.

It turns out that dives in which more lunges occurred were generally longer, preceded and followed by more breaths and resulted in more time spent at the surface afterwards. This appears to show that lunge feeding does have a high energetic cost associated with it. Also, whales tended to descend and ascend at a steeper angle on dives with much lunging than on dives with no or infrequent lunging. This is likely associated with where the whales are finding their prey. Whales tend to feed at the shallowest border of high prey density areas, and this steep descent/ascent is likely a method to maximize feeding potential. Where whales descend and ascend more gradually, they are likely seeking areas of higher prey density.

The implications of this study are than lunge feeding is fairly energetically expensive, and respiratory compensation does in fact occur, as evidenced by higher breath counts and greater time spent on the surface after lunge-feeding dives. In fact, whales returning to the surface after having dived and lunged 10-15 times had a respiration rate at least three times of that of whales that had dived and not lunged at all.

Road Sign.

submitted by Ian McEwen

Third Essay: A Cavalcade of Chameleons.

by Kristian Brevik

The title of the 2008 paper 'A unique life history among tetrapods: An annual chameleon living mostly as an egg.' describes well the contents of the work. As probably seems evident, the vast majority of four-limbed vertebrates have lifespans of more than one year. In fact, only a few marsupials and some lizards exhibit lifespans close to one year in length, but even they are capable of living for more than twelve months and can reproduce more than once during their lifespan. This paper describes the life history of a species of chameleon from Madagascar that, true to the paper's title, is truly unique.

Furcifer labordi is native to the southwest of Madagascar, and has adapted to the arid environmental conditions of the area. Over the course of five years, researchers observed the population of this chameleon in order to determine its life history. During the dry season, the entire population of *F. labordi* is represented only by developing eggs. These eggs remain unhatched for 8-9 months, until the wet season arrives and conditions are more suitable for adults. After the chameleons hatch, they only live for four to five months outside the egg. All of the chameleons hatch at the same time, and so all the individuals of *F. labordi* in the population are of approximately the same age. They reach sexual maturity in less than two months, reproduce, lay their eggs, and then the entire population rapidly exhibits senescence and dies.

Furcifer labordi is the only species of tetrapod known to have an annual life history. The authors admit that the reasons why this species has such an unusual life history are not known, though they suggest several hypotheses that may shed some light on the matter. The first hypothesis they suggest is that this life history pattern is well suited to environments that exhibit extreme differences in conditions between seasons. This allows the species to survive the harsher, arid dry season by remaining as embryos inside an egg, and only emerging as adults when conditions are relatively milder. However, another strategy that other species living in the same area has adopted is one with longer lifespans. This divergence is due to one primary factor. If random changes in the environment kill more juveniles than adults, then lifespans will lengthen in the population. If those random changes kill more adults than juveniles, the population will evolve shorter life spans. Random changes in conditions increasing the mortality of adults relative to juveniles could explain the evolution of the life history of *F. labordi*.

The second hypothesis similar to the first, but differs in the way it would bring about a change to the current life history. If an organism devotes resources towards reproduction instead of towards growth and maintenance of its body, its longevity will likely be reduced. A change over evolutionary history in the level of hormones involved in the regulation of resource allocation could have changed the levels of resources devoted to either growth or to reproduction. This change could have resulted in a change in the life history of the organism to the annual life history we see today.

Among tetrapods exist a wide variety of life histories. Some organisms live decades, reproduce late in life and have few offspring, while others live for only a few years, reach sexual maturity quickly, and have many offspring. The presence of such an extreme life history in a chameleon has the potential to teach us quite a bit about the life histories of tetrapods. F. labordi is closely related to species of chameleon that live longer than one year, and so can tell us about the different effects an extreme environment can have on the life history of closely related species.

Only two more submissions from Kristian Brevik.

by Ian McEwen

Damnit. Damnit, Kristian Brevik.

But damnit, I'm going to lay out all **ten** of your submissions, and I will not put any two of them next to each other without a section break between them.

I do this shit right.

That's fucking right.

John Ostrom.

by Kristian Brevik

John Ostrom (February 18, 1928 – July 16, 2005) was an American paleontologist who is widely credited with triggering the so-called "dinosaur revolution" of the 1960's and 70's. At the time when Ostrom began his work, dinosaurs were still considered to be basically large reptiles. They were thought of as slow, lumbering beasts, as for example, both sauropods and hadrosaurs were considered to be water-dwelling, for how could so large a creature support itself on dry land? Ostrom challenged these preconceptions by showing in a series of papers, focusing on the functional morphology of his chosen specimens, that if one wishes to choose a modern-day analogue to dinosaurs, birds are a much better choice than dinosaurs. His earliest work focused on the hadrosaurs, large herbivores that had been written off as slow-moving, swamp dwellers that consumed soft water plants. Ostrom's reanalysis of their morphology and habitat showed that hadrosaurs were active land dwellers than moved in large social groups and consumed mostly tough, fibrous plants. He next work dealt with the biology of the ceratopsians, redefining them as active herd dwellers as well.

Arguably his most important contribution to the study of dinosaurs was the discovery and description in 1969 of *Deinonychus antirrhopus*, "the terrible claw", a small theropod dinosaur from the Early Cretaceous. From the functional morphology of the limbs and and claws, the biology of this dinosaur was clearly not slow and lumbering, it must have been a bipedial, upright, active predator, (which lived in packs, but we didnt know that until a year ago). Deinonychus played two major roles in the transformation of the conception of dinosaurs. First, such a nimble active predator would likely have been warm-blooded, challenging the generally-held assumption at the time that dinosaurs were cold-blooded. Ostrom demosntrated ina series of papers that dinosaurs, at least some dinosaurs, were most certainly endothermic. The recent discovery of feathers on dinosaurs functionally incapable of flight is a further strong suggestion of endothermy, for among extant animals, only endothermic groups have such conspicuois insulating structures. One of Ostrom's graduate students, Robert Bakker, became one of the leading spokesdude for the concept of warm-blooded dinosaurs.

The second reason Deinonychus was such an important discovery was related to the origin of birds. Much of Ostrom's later work focused on the origin of birds and the origin of flight among dinosaurs. Through thourough understanding of osteology, he was able to recognize the remarkable similarity between Archeopteryx and Deinonychus, leading the way to studies showing that birds are in fact descended from dinosaurs. From this followed many papers exploring the possible explanations for the evolution of flight and the anatomical modifications that may have taken place.

Ostrom's PhD dissertation described the cranial morphology of hadrosaurian dinosaurs, better known as 'duck-billed' dinosaurs. Many members of this family of large herbivorous dinosaurs had conspicious cranial crests, and the discussion of these was a major focus of Ostrom's first few papers, which all focused on either describing a new species or describing the cranial crests of previously discovered specimens. However, it is his 1964 paper 'A reconsideration of the paleoecology of hadrosaurian dinosaurs' that changed the way we view hadrosaurs. Before this paper, and since the discovery of hadrosaurs in 1858 by William Foulke, hadrosaurs had generally been considered to have an aquatic lifestyle, eating soft water plants and only occasionaly venturing up onto land. This interpretation was begun in 1858 by paleontologists who made remarks on the likely amphibious lifestyle of hadrosaurs, and by E.D. Cope in 1883 who wrote that

"The nature of the beak and the dentition indicate, for this strange animal, a diet of soft vegetable matter. It could not have eaten the branches of trees since any pressure sufficient for their comminution would have probably broken the slightly attached teeth of the lower jaw from their places and have scattered them on the floor of the mouth..." (Ostrom 1964)

Ostrom states that this is "perhaps the priniciple misconception of hadrosaurian liviung habits...it is quite probable that Cope was misled by the accidental absence of the lingual wall of the dentary [bone], for hadrosaurian teeth are certainly neither 'slightly attached' not 'delicate'." (Ostrom 1964) In fact, the teeth of hadrosaurs are some of the most sturdy and resiliant found among dinosaurs. They are not only firmly held in place by bone and cement, but some specimens exhibit teeth that are firmly anchored even though the crown of the tooth is fully worn away. Ostrom challenged the currently held notions of hadrosaur ecology by firmly and effectively go-

ing though the availably evidence (environment, diet, and morphological) and showing that indeed, all of the "evidence presently available is in direct opposition to this interpretation."

The first area of Ostrom looks at is the physical environment in which hadrosaurs lived. He blames the conception of hadrosaurs as aquatic or amphibious on the discovery locale of the first hadrosaur fossil - in an ancient riverbed. On a closer look at the fossil evidence, a very different picture of the environment emerges. The rocks in which hadrosaurs fossils are found indicate that the enviroment they inhabited were likely a large coastal floodplains, probably fairly flat and with many swamps and large rivers flowing to estuarine deltas. So while there were swamps present in the habitat where hadrosaurs lived, it was primarily a terrestrial habitat. In addition to this, there are present dozens of other herbivorous dinosaurs in the same or similar deposits, indicating that these environments were lush enough to support large numbers of potentially competing herbivores. Ostrom also notes that while there (at the time of publication) was no direct evidence of theropod predation upon hadrosaurs, their presence in the fossil record makes predation a possibility. Even more important than these other dinosaurs in interpreting the ecology of hadrosaurs are the species of plants available in the area, for these dictate the possible diets of hadrosaurs. Ostrom presents an exhaustive (4-page) list of flora genera contemporaneous with known hadrosaur fossils. Of these, an overwhelming majority of 86 percent are terrestrial woodland types, while 8 percent are marginal between terrestrial and aquatic environments, and *only 6 percent* are aquatic plant genera. The habitat of the hadrosaurs, as opposed to being a marsh, appears to have been "...characterized by rich and diverse, lowland forests, dominated by conifers, poplars, willows, and oaks." (Ostrom 1964)

This new interpretation of the hadrosaurs' habitat makes clear that the previously assumed diet of hadrosaurs, swamp plants, must be reinterpreted. Ostrom uses both anatomical evidence of the dinosaurs themselves along with detailed botanical evidence of the types of plants coexistent with hadrosaurs. First, the anatomical evidence, primary the teeth. In most cases, the teeth of an organism are some of the most telling about its diet and ecology. In the case of hadrosaurs, their teeth form a highly specialized 'dental battery'. The teeth are specialized in such a fashion as to be almost certainly used for a diet of hard, fibrous, or even woody plant tissues, quite contrary to the previous belief in a mushy, water plant diet. The teeth also show a mechanism of tooth replacement, as seen in other animals that have a diet of tough plants (Ostrom mentions the elephant, beaver, and horse), such as to provide a constant grinding surface throughout the animals' life. Ostrom's dissertation research comes into play here, where he described the tooth morphology in much detail. The movement of the mandible was quite complex and even 'rodent-like' in the way it moved. The last bit of mouth morphology that Ostrom describes is the "beak". Since it superficially resembles the beak of a duck, the form of the beak reinforced the belief in a dabbling water plant feeder. However, as this feeding strategy does not fit the evidence, the beak was was possibly used instead for stripping leaves from branches. In addition to the flora surveys previously mentioned, a 1922 paper describes the discovery of many conifer needles as well as pieces of other land plants in a hadrosaur "mummy's" preserved stomach.

The killing blow Ostrom sledges into our previous understanding of hadrosaur ecology comes from his analysis of their skeletal modifications for terrestrial locomotion. The length and structure of the limbs suggest a primarily bipedal stature, and the articular surfaces of all the hind limb bones are very well defined, indicative of active locomotion rather than aquatic or amphibious dwelling. This along with prominent muscle attachment sites for those muscles involved in bipedal locomotion and an extensive network of ossified tendons running dorsal to the vertebrae in perhaps to aid in balance or counteract stresses in the spine lend lends further evidence to the bipedal, terrestrial lifestyle of hadrosaurs.

However, two anatomic features of hadrosaurs seem to be adaptive towards an aquatic environment. The first is the "paddle-like" manus suggested when 'mummified' hadrosaurs were described with their skin partially preserved to show the outline of the hand. The second is the large laterally compressed tail that one would expect to see in a swimming animal, such as crocodiles. However, both of these apparent adaptations are not as clear as they appear to be. The laterally flattened tail of hadrosaurs was made very rigid by the ossified network of tendons and would have been of very little use for aquatic locomotion. Ostrom suggests that the webbing was perhaps useful for overland migrations that may have passed through marsh and river terrain. However, later studies suggest that this webbing was actually deflated foot padding, such as that seen in elephants. (CITATION NEEDED). Ostrom ends the paper with a suggestion that perhaps hadrosaurs did resort to water as an escape from predators, as they do not appear to have any other defensive adaptations, such as a skeleton fitted for rapid flight or horns and spikes.

This early paper demonstrates Ostrom's skill at clearly and effectively challenging pre-existing notions and replacing them with a clear and valid theory. This skill would come into play many times in Ostrom's career, and it is this that his reputation as the instigator of the dinosaur revolution is built.

In the summer of 1964 during an expedition in Wyoming and Montana Ostrom discovered a small theropod dinosaur that was to revolutionize the way we view their lifestyle and their descendents. This little dinosaur was named *Deinonychus antirrhopus,* 'counter-balancing terrible claw'. In 1969 Ostrom published an extensive monograph detailing the osteology and hypothetical behavior of Deinonychus. The vast majority of the monograph describes each and every bone in detail. While this is the most important step in determining or hypothesising the lifestyle and ecology of the dinosaur, I will try to pick out the pieces that make Deinonychus a truly remarkable dinosaur.

First, the anatomy of the fore limbs and hands could not have been used for locomotion, and this along with the length difference between the forelimb and the hindlimb indicate that Deinonychus was most certainly a biped. (The anatomy and possible use of the forelimb was postulated upon in a later paper, see below, as the coracoid was misidentified due to its enourmous size.) The hindlimbs, while long, are not as long relative to other bipedal dinosaurs or extant ratites, or even other theropods. It is generally the case that leg length is a good indicator of speed in an animal, including extant mammals and birds. In most cases, the length of the femur and the tibia are compared to the length of the finger bones (epipodials, generally greatly increased in running animals) to estimate running speed. Unfortunately in the specimens of Deinonychus described, the femur is absent, so this comparison is unavailable. However, another available comparison is found in the wrist bones (metapodials). In most cases, fast running animals have long epipodials and metapodials. The length of these bones compared to the length of the tibia are a good indicator of speed. However, Deinonychus has a metatarsal/tibia ratio that is fairly small (48 percent) relative to other dinosaurs that are considered fleet of foot. For example, Ornithomimus has a metatarsal/tibia length of 70 percent and Ornitholestes, a dinosaur closely related to Deinonychus, has a ratio of 75 percent. While this means that Deinonychus may not have been the fastest dinosaur, or even as fast as other theropods, another anatomical ratio comes to the fore to suggest a reason for this discrepancy.

The longer a distal limb is, the less force can be exerted at the end, simply as a ratio of the lever arm physics. One explanation of Deinonychus' shorter limb length has to do with its highly modified second toe, where instead of a normal-sized claw, an enormous scimitar shaped claw is raised above the others. This claw, Ostrom says, was likely used as a slashing weapon to disembowel or dismember prey items. It was, Ostrom writes, "a highly specialized, sickle-like talon on the inner toe- a four or five inch-long weapon that could only have been used for cutting and slashing." Deinonychus' shorter limb length would have increased the force available for such activity. This suggests that Deinonychus used its large claw as a weapon for predation, and while today the idea of the 'raptor' is quite mainstream, in Ostrom's day this was quite unusual behavior for a sluggish reptile.

The hands of Deinonychus also suggest active predation. The forelimbs are quite long compared to other theropods (up to 70 percent of hind-limb length, as compared to 42 percent in Allosaurus and 20 percent in Tyrannosaurus Rex) and exhibit numerous modifications that indicate that they were 'raptorial', or used to grasp the dinosaur's prey. The deltopectoral crest on the humerus is extremely large compared to other theropods. As this is the insertion site for many muscles, the pectoralis and coracobrachialis on the inner side and the deltoid, brachialis and humeroradialis on the outer side. The pectoralis and coracobrachialis muscles are the major flexors of the arm, they decrease the angle of the shoulder, bringing the arm towards the body. The deltoid swings the humerus forward and the brachialis and humeroradialis flex the forearm. This muscle configuration seems to indicate that Deinonychus had an unsually strong forearm flexion, which would have allowed it to strongly grasp and subdue prey. The fingers of Deinonychus' hand account for almost of the total length of the arm, quite remarkable considering the tiny (though strong) hands of T. rex. The digits end in large recurved claws, and the third digit of three on the hand (the other two are lost) seems to be able to be extended away from the other two digits, similar to the way primate thumbs can move away from the rest of the digits, though this does not indicate opposability. All of the unguals have large attachment points for flexor muscles, indicating that Deinonychus had an extremely powerful grip.

"There can be little doubt that the hands and forelimbs of Deinonychus were well-adapted for grasping and holding... I am inclined to relate fore limb length in Deinonychus to the unusual claw on the second pedal digit. If this claw was used to kill prey held by the hands, the prey quite obviously could not have been held close to the body. The foot claw could only been applied to objects

held at arm's length. Moveover, it seems quite possible that on some occasions the fore limbs and hands were essential to the effective use of the sickle-like foot claw, immobilizing the prey and bracing it against the retractive power stroke of the hind leg." (Ostrom 1969)

It is also interesting to note that extant ratite birds are capable of disemboweling or dismembering folks with their inner toes if they are cornered, using powerful slashes.

Another anatomical feature contributes to the view of Deinonychus as an active predator, its stiffened tail, which "appears to have been the critical stabilizing mechanism as predator and prey struggled." (Ostrom 1969) The tail appears to have been held out straight from the body, supported and reinforced by the chevron bones (bones ventral to the vertebrae) and the prezygpophyses, both of which have been modified into elongated reinforcing rods. Thus, the tail was stiff, though it was was flexible at the juncture with the main body. The function of this reinforcement was likely to provide a 'dynamic stabilizer', similar to the balancing pole of a tightrope walker.

All of these anatomical features taken into account, Deinonychus appears as an active agile predator, likely grasping its prey in its forearms and slashing it open with its highly modified claw, all the while using its rigid tail to balance. While this would be effective for smaller prey, the large size of the pedal claw in addition to the large skull and jaws suggest that prey larger than Deinonychus could have been attempted. This would likely have been easier in a group, and a gregarious nature of Deinonychus is suggested in the fact that a group of animals, along with an ornithopod four or five times the size of Deinonychus, were all discovered together in the same fossil deposit. Since these specimens were certainly buried together, it is likely that Deinonychus were associated with the ornithopod. Also interested, Ostrom notes, is that Deinonychus-type teeth have been found associated with moderate size ornithopods at fourteen other sites in the area where Deinonychus was found.

However, in this 1969 paper, the coracoid was found to be not complete, and so "no evidence pertaining to its size, shape, or the nature of its junction with the scapula" could be found or described. In 1973 Ostrom published "The pectoral girdle and forelimb function of Deinonychus: A correction". It turns out that the coracoid was complete, but because of its huge size, two to three times larger than was to be expected, it was mistaken for the pubis. The coracoid, which together with the scapula forms the scapulocoracoid, forms the attachment site for many muscles that are involved with anteromedial adduction of the humerus and anteromedial flexion of the forearm, the 'bear-hug' muscles. The remarkably huge coracoid of Deinonychus would have allowed for an extremely strong grasp and holding capability. Also in this paper Ostrom uses the morphology of the complete forearm to show that "the humerus of Deinonychus was normally carried in a "retracted" position against the body similar to the folded wing position of birds." (Ostrom 1973) It is from this position that Deinonychus could have rapidly moved its arms forward and away from the body and flexed its forearms forward. These movements were likely very important in catching prey, and it is interesting to note that some extant birds use a similar arm movement in predation, a point which I shall be returning to.

Before Ostrom began to publish papers describing the relationship of dinosaurs to birds, in 1969 he published 'Terrestrial vertebrates as indicators of Mesozoic climates', an influential paper that looks at the evidence of homeothermy or endothermy in dinosaurs. The reason that this was an interesting topic at the time (the same year Deinonychus was described) was because when paleontologists attempt to reconstruct past climates, the distribution of animals plays an important role. Since reptiles are cold-blooded, or poikilothermic, and can only thrive at certain climes, they were treated as indicators of climate. While this is all well and good for groups that we are quite certain were cold blooded, such as amphibians, this technique runs into trouble if the organism in question is actually warm-blooded. Ostrom says that "there is considerable evidence... that many different kinds of ancient reptiles were characterized by mammalian or avian levels of metabolism and were probably homeothermic, if not actually endothermic." (Ostrom 1969) Ostrom devotes the remainder of the paper to detailing this evidence.

While determination of this trait is relatively straightforward for extant species, not so for the dinosaurs. Since direct observation of extinct animals is impossible, one has to rely on indirect evidence to support any claim about the habits or physiology of such animals. One way to compensate for this lack of data is to compare the behavior of extant species with similar osteology or ecological niche. Ostrom begins by describing the physiological differences between poikilotherms (amphibians, reptiles, monotremes) and homeotherms (birds and placental mammals) in terms of the caloric intake necessary to maintain their temperatures. Birds and mammals use orders of magnitude more energy than amphibians and reptiles to maintain a higher metabolism and through this, a higher body temperature. There are many benefits

to this, not least the ability to feed at any time and at any temperature, while cold-blooded animals are too cold and torpid to feed.

Ostrom notes that all extant dominant terrestrial tetrapods, namely birds and mammals, all have fairly constant body temperatures above 35 degrees Celsius, all are homeothermic within a range, and have relatively high basal metabolism. They also all happen to have an erect or upright posture in which the limbs are positioned vertically below the body as opposed to in a sprawling position. This upright posture takes calories to maintain, and no cold-blooded animal is able to obtain such a posture for long. This posture is clearly evident in limb bone structure, as the position of the articulations with the rest of the skeleton and the nature of the articulation itself show in what position the legs were held. In order to determine the posture of the dinosaurs, all one has to do is look at the leg bones, and from them it is very clear that dinosaurs walked erect. There were several groups of dinosaur that had bipedal capability, and some groups (some prosauropods, all theropods, most ornithopods) that were obligatory bipeds. While this is not conclusive evidence, it suggests that dinosaurs were not cold-blooded and sluggish, but rather active homeothermic animals. Ostrom's conclusion that dinosaurs were probably homeothermic suggests that dinosaurs are not good subjects for paleoclimatogical predictions, as they would not have been restricted in their distribution as cold-blooded reptiles would be.

While this short paper only touches on the question of dinosaur homeothermy/endothermy, in 1978 Ostrom presented at the AAAS symposium on dinosaur endothermy a paper titled, "The Evidence for Endothermy in Dinosaurs". This paper gives an in-depth look at a broad scope of evidence, as the title suggests. (It is also interesting to note that one of Ostrom's PhD students, Robert Bakker, who worked with Ostrom excavating and describing [and drawing the plates] Deinonychus, presented a 100 page paper at this symposium as well. Bakker has been described as evangelical where Ostrom was cautious, but more on him later.) The evidence that Ostrom details falls into nine categories:1) posture and gait, 2) haemodynamics, 3) activity levels, 4) group activity, 5) feeding adaptations, 6) predator-prey ratios, 7) bone histology, 8) dinosaur zoogeography, and last but perhaps most interesting, 9) bird origins. However, Ostrom makes clear that all of this evidence only completely applied to the theropods. As dinosaurs were varied and diverse, their metabolisms may have been so also, and the evidence presented may not apply to all groups.

The first line of evidence, that of posture and gait, was detailed in Ostrom's 1969 paper, so I won't go too in depth here. He does note that the evidence of dinosaur trackways and their narrow breadth is further indication of their upright, non-sprawling posture. Although he reiterates in this paper the thought he mentioned previously, that this upright posture is not necessarily correlated, he does say that no other explanation for the correlation has been provided, and at least two groups of dinosaurs were obligate bipeds.

Haemodynamics is the study of bloodflow and circulation. We don't have any dinosaur blood laying around, so how is this helpful to determining their physiology? Through skeletal analysis, we can determine the vertical distance between the head and heart of a dinosaur. With this, we can calculate the probable systemic blood pressure needed to get blood all the way to the head. For some large sauropods, it is calculated that they would need 500 Hg of pressure in the systemic tract. However, this amount of pressure in the lungs would likely damage them irrevocably. In order to keep pressure in the pulmonary tract low, it has been suggested that at least the larger species of dinosaur would have necessarily had a fully divided four-chambered heart. Ostrom notes that here again, while a four-chambered heart is not necessarily indicative of endothermy, among extant species, only endothermic animals with high metabolic rates have evolved four-chambered hearts and have blood pressures high enough to have sustained a sauropod. This suggests that a four-chambered heart is a necessary precondition

for endothermy.

Ostrom cites Bakker (1968, 1971, 1972, 1974) as adamantly describing the skeletal morphology, specifically limb bone and joint morphology as indicative of both high running speeds and high activity levels. He states that the traits found in dinosaurs are found in modern birds and mammals but are not found in crocodilians or other reptiles. This suggests that dinosaurs were endothermic, and certainly an endothermic physiology would be mighty beneficial for a speedy active dinosaur. Ostrom mentions and addresses two criticisms of dinosaurs as highly active. The first is that dinosaurs brains were too small to be able to control the muscles and senses of a endothermic animal. While this may be valid, dinosaur brains were relatively larger than crocodilian brains and might not have been so small as to preclude endothermic levels of control. The second criticism, that footprints of running dinosaurs have not been found, falls when one considers that even birds and mammals very rarely run at their maximum velocities, so a record of these speeds for dinosaurs would be hard to come by.

Group behavior in dinosaurs is suggested by two main sources of evidence: group death and fossilization and group trackways, both of which have been described extensively. While it is hard to doubt that at least some dinosaurs were social in the manner of birds and mammals, complex social behavior has also been observed in ectotherms. So while the gregarious nature of dinosaurs further suggests endothermy, it does not prove it.

Endothermic metabolism takes a lot of calories to maintain. If dinosaurs were indeed endothermic, we would expect to find some adaptations that would allow them to consume large quantities of food at a rate rapid enough to maintain their bodies. And luckily, we do. Both the ornithopods (hadrosaurs, etc), and the ceratopsians exhibit specialized teeth, similar to those of elephants, suited to the processing of large volumes of plant matter. These teeth also were able to regenerate constantly throughout the animals' lives, ensuring that no matter how ground down the teeth became, there would always be a chewing surface available. Since these adaptations are today found only in endothermic mammals, it suggests a high volume of food intake. Sauropods, the largest of the dinosaurs, do not exhibit these adaptations, however, evidence has been found that sauropods had gizzards full of stones to grind up their food. Another adaptation found in a variety of herbivorous dinosaurs is a diverted nasal passage. In extant non-crocodilian reptiles air passes through the mouth on the way to the lungs, but in many herbivores it appears that the nasal passages bypass the mouth entirely. This would allow the dinosaur to breathe without interfering with eating. However, these adaptations may have simply evolved due to the large size of the dinosaurs involved, and may not be evidence for endothermy after all.

Related to feeding adaptations is predator-prey ratio, this time useful in determining whether or not the predatory dinosaurs, the theropods, were endothermic. Bakker was instrumental in studying this topic, and Ostrom mentions several papers that deal with this topic. Since endothermic predators need to eat so much more than ectothermic predators (their weight every six to nine days as opposed to every 60 or so days for ectotherms), a certain population of prey species can only support so many endothermic predators. In modern mammal populations, predators generally make up 6% of the population, while if those predators were ectothermic their populations could be up to 60% of the total. By determining the ratio of predatory to herbivorous dinosaurs in a fossil bed, one could get an idea of how many predators a population of herbivores could support, and this could indicate the physiology of the predators (though it doesn't tell us anything about the herbivores). It turns out that predatory dinosaurs made up about 3-5% of a certain fossil bed in Alberta- just the ratio we would expect if the predators were endothermic. Ostrom is very clear in making sure we understand that this only tells us about the predators, not the herbivores, but since endothermic birds evolved from theropods, their being warm blooded would come as no surprise.

The compact bone of most ectotherms does not have many blood vessels running through it, while the compact bone of most endotherms is highly vascularized by what are termed Haversian canals, which are created throughout an animals lifetime. This is thought to be related to the higher metabolic needs of calcium and phosphorus in endotherms, but other evidence shows that since many ectotherms do in fact have high proportions of Haversian bone and many small endotherms lack it, it may be related to some other process, such as growth or body size. Dinosaurs *do exhibit* a large proportion of Haversian bone, so if indeed it is related to endothermy, its presence in dinosaurs is more evidence for endothermic physiology. However, due to the variable nature of such bone, this data is not conclusive.

The fact that dinosaurs were extant at high latitutes that are now uninhabitable by ectothermic species has been used as evidence of their endothermy. However, Ostrom concludes that since the climate during the Mesozoic was significantly warmer than the present, this

distribution at high elevations and latitudes provides no evidence for or against the endothermy of dinosaurs.

The last line of evidence that Ostrom presents is that of the evolution of birds from theropod dinosaurs. In fact, Ostrom states, “had these [Archeopteryx] specimens been preserved without clear impressions of feathers, they would have been identified as small theropods.” Since all birds are endothermic, it suggests the possibility that theropod dinosaurs were also endothermic. The feather covering of Archeopteryx provides further evidence, as feathers likely evolved as insulation, something a sun-basking ectotherm does not require. While this is also not conclusive, it his highly suggestive of endothermic theropods.

Ostrom concludes by noting that while all of these lines of evidence can be explained in other ways, none of those explanations disprove endothermy in dinosaurs. He says that “all the lines of evidence are extremely interesting and highly suggestive, but they are far from conclusive... Personally, I believe that some dinosaurs - especially the theropods, to which all lines of evidence seem to apply, were probably endothermic...The vast majority, however, I suspect were ectothermic “homeotherms”... that is, they were ‘warm-blooded’ by virtue of their ectothermic response to a warm and equable environment.”

One of Ostrom’s most influential contributions to the study of dinosaurs was not, however, to directly deal with the ectothermy-endothermy debate. While he touched upon it in his earlier papers, Ostrom’s work on the origin of flight was expanded greatly in later papers. The first paper he published on the subject was in 1973 in the journal Nature, titled “The ancestry of birds.” While only a page long, it lists over 25 skeletal traits that almost certainly conclude that birds are decended from dinosaurs. Ostrom states that, “The skeletal anatomy of Archeopteryx is almost entirely that of a coelurosaurian dinosaur...” This paper is the first of many that helped to solidify the position of birds as the descendants of dinosaurs. In 1974, Ostrom published a second paper on the subject, “Archeopteryx and the origin of flight.”

In this paper, Ostrom examines the two leading hypotheses for the origin of avian flight, the arboreal and cursorial theory, and then suggests a third hypothesis, the cursorial predator theory. The arboreal theory suggests that birds evolved from tree-dwelling reptiles and flight was an adaptation from gliding from tree to tree. Since most vertebrate “fliers” are arboreal gliders, it is easy to see the potential of this hypothesis. However, Ostrom notes that it would be very unlikely if all vertebrate flight mechanisms evolved in the same way. The cursorial theory holds that birds evolved from ground-running reptiles who gained a speed advantage from flapping while running. The cursorial predator hypothesis, which Ostrom backs up with osteology from he previous work, holds that the arms/wings were used in predation and that flight perhaps evolved as an adaptation to leaping up after insects. While flight is a remarkable adaptation for changing altitude - either ascent or decent - it is just as likely that flight arose as a mechanism of ascent as a modification from adaptations for controlled descent.

The arboreal theory of bird flight “maintains that primitive bird ancestors must have been tree-dwelling creatures that leaped from branch to branch or tree to tree” (Ostrom 1974) It was first expressed by Marsh in 1880 and until recently was very popular. Evidence used to support this hypothesis rely heavily on Archeopteryx specimens, especially the presence of claws which appear to be adapted for climbing, the bird-like foot which features the hallux (big toe) moved to the posterior of the foot, the well developed flight feathers, and the presence of a furcula, which is only known in carinate birds. Ostrom acknowledges the importance of this evidence, but states that the arboreal theory is not the best explanation of the data, and that other interpretations are much more plausible. The claws and hands of Archeopteryx are nearly identical to the hand of Deinonychus and Ornitholestes (IMAGE), which were certainly not arboreal animals, leading to the question of how it was determined that Archeopteryx was adapted to climbing. In addition, furcula (wishbone) have been found in many theropods, including Tyrannosaurus Rex, indicating that they had some other adaptive function before the advent of flight.

The cursorial theory of bird flight origins was first suggested in 1879, but went relatively unnoticed until 1907, when it was revived by Nopcsa, who held that “the anterior appendages gradually became modified into wings as a result of flapping action that supposedly assisted in running.” (Ostrom 1974) The creature who would have developed these wings would have been a cursorial dinosaur-like reptile, similar in form to Archeopteryx. The line of evidence used in support of this theory was also primarily based on the osteology of Archopteryx, which indicates that the ancestors of birds were cursorial. Archeopteryx has three digits on its feet, and a fourth digit (the hallux, big toe) that has been diverted to the rear of the foot, a united or fused metatarsus, a mesotarsal ankle joint (a joint in the middle of the ankle), and a vertical, obligatory bipedal position of the hind legs. What is most interesting about these traits is that they are shared with most theropod dinosaurs, which were most certainly

cursorial. The fact that these traits are shared is evidence that they were at the very least functional analogues, if not direct homologues. Ostrom concludes by stating that this theory is correct in one aspect, that birds descended from a cursorial ancestor. However, they would not have developed flight to gain a speed advantage while running, for any advantage gained in this way would have been lost due to decreased traction. So while this theory is partially correct, it requires some refinement.

The third, new theory that Ostrom suggests is the cursorial predator theory. Ostrom begins this presentation by bringing up two concepts which have influenced any previous hypotheses of the origin of flight. The first is that is had been assumed that the seeming similarity between Archeopteryx and theropod dinosaurs was due to merely convergent evolution. The second is that the traits that seem to be dinosaurian in nature (primarily limb, hand, and foot osteology) were actually related to the first steps in the origin of flight. Ostrom concludes, however, that while these traits are most likely due to phyletic affinity, they are most certainly functional analogues, and so for the purposes of determining the origin of flight, examining the phyletic relationship of birds to dinosaurs is not necessary.

Since the osteology of Archopteryx is nearly identical with that of ground-running predatory theropods, Ostrom believes that it was an active bipedal ground-running predator that used its hands and arms primarily for predation, and so its entire pectoral girdle was adapted for this purpose. While these adaptations do not preclude an arboreal lifestyle, they do not show any particular adaptation to it. When Ostrom described Deinonychus, he described its forelimb as being primarily adapted for grasping prey items and bringing them towards the body. It was this, Ostrom claims, that most likely preadapted Archopteryx for flight. This use of the arm requires strong pectoral muscles, to say the least, which would have provided the power needed for a wing downstroke in powered flight.

From the dentition and skull morphology of Archeopteryx we can conclude that it ate insects and perhaps small animals. The presence of large contour feathers on the forelimb, which were assumed to be flight feathers, could have also functioned as a sort of prey-catching snare, forming a trapping device in which to surround small prey items so that they could not escape, and also preventing flying insects from flying away. (Note: While Ostrom doesn't mention it, this predation strategy is employed by a number of modern birds, further increasing its plausibility.) This adaptation could have easily moved towards a sort of 'flapping motion', leading to the ability of flying up short distances after escaping flying insects or other prey. This behavior could have selected for both increased wing feather size, modifications in the osteology of the wing to increase efficiency, and increased control of the flight mechanisms. This theory of the origin of flight is supported by all of the osteological evidence, and does not rely on a hypothetical arboreal stage, which is not necessitated by any of the evidence.

Before concluding, Ostrom makes a few more salient points. First, the reversed hallux has long been cited as an adaptation for perching, however, this trait is common to all theropods, and he states that it would be unlikely for anyone to 'advocate a tree-perching habit for... Tyrannosaurus..." (Ostrom 1974) The morphology of the terminal phalanges on the foot, the claw-bearing bones, of Archeopteryx, are much more similar to those of other cursorial runners than to any perching bird. Also, the claws of the hand, while being characterized as useful for climbing, are so similar to the certainly claws of predatory theropods that this explanation is surely lacking.

Also in this paper, Ostrom discusses the possible origin of feathers. The most accepted theory is that feathers evolved as thermal insulation. This explains the origin of feathers in the first place, but the feathers of Archeopteryx appear to be modified for uses other than insulation. Especially, how does one explain feathers on the forelimb of Archeopteryx, which seem so clearly to be flight feathers. Here Ostrom brings up an incredibly important point. If feathers evolved in relation to flight, why would the feathers of Archeopteryx be so well developed when there is pretty much no other evident modification for flight? The entire anatomy of Archeopteryx, as has already been stated, is essentially that of a cursorial theropod dinosaur. The modifications from this to the skeleton of a modern bird are numerous: The carpus and metacarpus are unfused, the wrist and elbow joints are unrestricted, the humerus is not modified, the coracoids are as in theropods and appear not to have braced against the sternum, there is no sign of a sternum or its keel, and the flight feathers seem not to have been attached to the forelimb skeleton..." From this Ostrom concludes that feathers must have served some other adaptive purpose, so when the skeletal and other modifications for flight began to occur, feathers were already extant in a very advanced form.

Ostrom concludes by restating the striking similarity of the limb of Archeopteryx to the limbs of certain theropod dinosaurs, including Deinonychus, and the many dissimilarities to the wings of modern birds. It was

most likely that the forelimb of Archeopteryx was used in a grasping, predatory fashion and that the feathers on it provided some sort of trap for prey. Only later did this preadaptation allow for the development of flight.

However, this paper did not touch on the possible origin of birds in a cladistic manner. In 1975, Ostrom published "The Origin of Birds", in which he came to the conclusion that "The data...lead me to the conclusion that the dinosaurian theory of bird origins is correct after all and that Archopteryx and all other birds are descendant from some small, Middle or Late Jurassic theropod dinosaur. Contrary to some previous conclusions, there is no positive evidence against a thecodont -> theropod -> Archeopteryx -> modern birds, evolutionary sequence." (Ostrom 1975) (FIGURE 9) How did Ostrom reach this conclusion? He focused on the functional morphology of the skeleton of Archeopteryx and compared it to theropod dinosaurs and to the other candidate of dinosaur ancestor, the thecodonts.

It has long been held that birds are descended from reptiles. The thecodonts, primitive archosaurian reptiles, are almost certainly the ancestors of crocodiles, the extinct flying reptiles, pterosaurs, as well as all dinosaurs and birds. However, the general consensus before Ostrom's analyses was that bird evolved not from dinosaurs, but from the thecodonts directly. Ostrom claims than theropod dinosaurs are in fact the immediate ancestors of birds, and he supports this claim magnificently.

First off, Ostrom describes the primary reasons why dinosaurs have been rejected as bird ancestors. The most often cited claim is that dinosaurs were too specialized to have evolved into birds. This is, Ostrom states, simply a failure to recognize how many of the features preserved in Archeopteryx are intermediate between dinosaurs and birds, even though many of the characters are unchanged or very similar to their condition in theropods. While this is not direct evidence, the one piece of direct evidence that is often cited is that theropods lack clavicles. While this is not a valid claim on several accounts (it is negative evidence, the clavicles could be identified as a rib, the furcula is dermal and so could either be missing or not ossified), it is simply not true. Clavicles have been identified in several species of theropod. Ostrom states that "it would thus appear the the only evidence...for rejection of a direct evolutionary relationship between dinosaurs and Archeopteryx does not in fact exist." He then begins the bulk of the paper describing the osteological features that show the evolutionary relationship between dinosaurs and Archeopteryx.

The skull and jaws: Since the skulls of available Archeopteryx skeletons are mostly badly crushed, only seven morphological traits are beyond dispute: 1) a large, circular ring containing a sclerotic ring, 2) the skull is triangular and tapered, with an expanded temporal region, 3) medium sized temporal fenestra, 4) narrow and elliptical nares, 5) short, sharp isodont teeth in both lower and upper jaws, 6) long shallow mandible with long retroarticular process, and 7) a forward sloping quadrate. While four of these characteristics are found in both thecodonts and theropods, the last three (long shallow mandible, forward sloping quadrate, and the long retroarticular process are typical conditions of theropods but are not found in thecodonts.

The vertebral column: While the presacral vertebral column in Archeopteryx is the same condition found in both thecodonts and theropods, small pleurocoels have been found in the posterior dorsal vertebrae, a condition found only in theropods. In addition, the number of vertebrae in Archeopteryx is closer to the number in theropods.

The pectoral arch: (Figure) The scapulocoracoid of Archeopteryx is quite unbird-like, however, it is very close to the morphology of theropod dinosaurs, with a long narrow scapula and a short, almost semicircular coracoid. This form differs quite greatly from the scapulocoracoid of any thecodont.

The forelimb: (Figure) The forelimb of Archeopteryx is remarkably similar to that of several theropods, Deinonychus included. The relative length of each of the three digits is the same, the proportion of the phalanges is all the same, the dominant element in the wrist is the lunate carpal distal bone which articulates in the same fashion in both Archeopteryx and theropods. The humeri of all are long and slender and display a well formed deltopectoral crest. Ostrom also mentions here one argument against the dinosaurian origin of birds: that all terrestrial bipedal animals trend towards reduced forelimbs. In the case of the theropods, which likely used their forelimbs in predation, this is not the case, and so the argument is easily dismissed.

The pelvic arch: The pelvis of Archeopteryx is comparable to the pelvis of theropods, and does not bear much relation to the pelvis of thecodonts. Thats all that really needs to be said.

The hindlimb: Although the hindlimb of Archeopteryx is more slender than that of theropods (and thus more birdlike) it all other respects it is comparable to theropod hindlimbs and not similiar at all to the hindlimbs of thecodonts.

Avian characteristics: The two most avian char-

acters that Archeopteryx has are feathers and the presence of a furcula (wishbone) formed from fused clavicles. While the furcula is suspected to have a function in powered flight, Archeopteryx does not exhibit any of the other skeletal modifications that birds possess for flight. While Archeopteryx has been described as bird-like, it is clear than in terms of osteology (which is mostly what we have access to), Archeopteryx is far more dinosaurian in character. These characteristics are the strongest yet for a direct evolutionary connection between theropod dinosaurs like Deinonychus and Archeopteryx, and so birds. In this concise and succinct paper, Ostrom essentially silences any debate on the evolution of birds from dinosaurs. However, it is in his next paper that he attempts to describe some of the transitions that must have taken place in the evolution of birds from dinosaurs.

Ostrom's 1976 paper, "Some hypothetical anatomical stages in the evolution of avian flight" explores some of the possible ways in which dinosaurs could have evolved flight mechanisms, including the highly modified muscles used for flight. He begins with the skeleton of Archeopteryx and shows the changes in morphology that occurred and possible ways in which they may have occurred. One major change involves the M. supracoracoideus muscle, which ancestrally pulls the humerus down and towards the body. However, in birds, it pulls the are up and away from the body. This was possibly achieved by the gradual expansion of the coracoid bone dorsally, slowly shifting the direction of pull of the muscle. However, Ostrom concludes that this and the other modifications he described could not have been developed until a fairly advanced stage of wing evolution, due to the mechanics of flight. Instead, he proposes that these advances were preadapted from other uses for the wing, for example, the prey catching mechanism described earlier.

Ostrom is rightly credited as one of the instigators of the so-called dinosaur renaissance. His work on the evolutionary relationships of dinosaurs and birds revolutionized the way we see both dinosaurs and birds. He achieved this amazing transformation primarily through the analysis of the functional morphology of skeletons. Through this analysis, he brought dinosaur paleontology to the forefront of evolutionary biology. But this way of reevaluating paleontological evidence was apparent from the beginning of his career. His reevaluation of hadrosaurs transformed them from sleepy giants into active terrestrial herbivores, and this, along with his discovery of the remarkable dinosaur Deinonychus, which was clearly an active predator, launched Ostrom into studying the possible homeothermy of dinosaurs. This research led still further when through his analysis and comparison of the skeletons of Archeopteryx to other theropods he came to the conclusion that dinosaurs are the direct ancestors of birds. The evolution of feathers as thermal insulating mechanisms and the bird-like behavior of some theropods all integrated together into one seamless picture, one of warm-blooded theropods with complex behavior gaining feathers and eventually evolving into warm-blooded birds. Recent discoveries of more and more feathered dinosaurs and the possible presence of feathers on all coelosaurs, including Tyrannosaurus Rex, only serve to reinforce his remarkable conclusions.

Thoughts on where I should go.... more recent work on bird/dinosaur phylogeny and feathered dinosaurs?.... gregarious dinosaurs

Also, the figures have not yet been inserted...

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Zerg Type:

Zerg are monstrous and deadly, mutated to be horrible killing machines, Zerg are dangerous foes.

Hit Die: d10.

Base Attack Bonus: As fighter (equal to HD).

Good Saving Throws: Fortitude and Reflex.

Skill Points: 0-15.

Feats: None (beyond bonus feats).

Example: Hydralisk.

Notes: All Zerg have the hive mind and fast healing abilities and are immune to all mind-influencing effects, disease, poison, and acid. All Zerg have darkvision with a range of 120 feet, and are immune to the effects of vacuums. Zerg capable of flight gain zero-g training as a bonus feat and may fly at their fly speed in a vacuum.

Hive mind (Ex): All Zerg are in constant communication with the Overlords, who are in constant communication with their Cerebrate. If one is aware of a particular danger, they all are. If one in a particular group is not flat-footed, none of them are. No Zerg in such a group is considered flanked unless all of them are. All Zerg units within one mile of an over-

art by Ben Batchelder

SECTION LIES

lord can see everything that it sees.

Fast healing (Ex): All Zerg heal at a rate of one hit point per hit die per hour.

The Creep: Creep is a thick organic bio-matter that Zerg eggs and structures use as nutrients. It is produced by some Zerg structures. Zerg that are in or on the Creep heal at twice the normal rate.

Broodling
Small Zerg
Hit Dice: 1/2d10 (2 hp)
Initiative: +2 (Dex)
Speed: 30 ft.
AC: 14 (+2 Dex, +1 natural, +1 size)
Attacks: Bite +1 melee
Damage: Bite 1d6
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits.
Saves: Fort +2 Ref +4 Will -3
Abilities: Str 11 Dex 14 Con 11 Int 1 Wis 4 Cha 3
Skills: Listen +1, Spot +1, Climb +4.
Feats: Weapon focus (bite).
Challenge Rating: 1/4
Advancement: None.

Broodlings are spawned by queens inside of other creatures, their life span is short, lasting only a few hours on average.

Combat:

Though small broodlings can be vary aggressive, attacking with their powerful beaks.

Defiler
Medium-Sized Zerg
Hit Dice: 4d10 (22 hp)
Initiative: +1 (Dex)
Speed: 30 ft. burrow 10 ft.
AC: 15 (+1 Dex, +4 natural)
Attacks: Touch +3
Damage: Touch poison
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: Plague, dark swarm.
Special Qualities: Zerg traits, poison, PR 18, fire and cold resistance 10.
Saves: Fort +4 Ref +5 Will +1
Abilities: Str 11 Dex 12 Con 10 Int 3 Wis 10 Cha 6
Skills: Listen +4, Spot +4, Climb +4.
Feats: -
Challenge Rating: 4
Advancement: 5-7 HD (medium-sized).

Defilers are the perfect example of the fanatic and sadistic nature of the Zerg. Like the larvae, the defiler carries the genetic code of every other Zerg breed, bit it does not produce them. To the contrary, the defiler uses these genetic matrices to produce cancer-like toxins which have dramatic and deadly effects.

Combat:

The Defiler prefers to avoid direct combat, relishing instead in the use of its unique bio-chemical abilities.

Poison (Ex): The touch of a defiler is poisonous to all non-Zerg. This poison deals 1d6 strength damage as initial damage and 1d6 constitution damage as secondary damage with a DC of 13.

Plague (Ex): With this ability, the defiler produces a batch of corrosive spores that it then explosively projects (range 50 feet) in a dense 10 foot radius cloud around its enemies. This highly toxic cloud corrodes anything caught within its midst, dealing 2d6 acid damage. A successful reflex save (DC 18) halves this damage. The acid continues to deal damage for two more rounds, dealing another 2d6 damage to all creatures affected (1d6 to anyone who made the reflex save) per round. All creatures hit by the toxin must make a fortitude save (DC 18 or 14 if they made the reflex save), or be poisoned (initial damage: 1d6 Con, secondary damage: 2d6 Con). This ability can be used once per day.

Dark Swarm (Ex): The body of the Defiler is covered with a countless number of smaller creatures that feed off each other. By spontaneously launching a number of these creatures into the fray, the defiler can create a thick cloud of living insects to distract the Swarm's enemies and provide cover for other breeds. This cloud acts as a fog cloud spell (caster level 5), except that all non-Zerg creatures within must make fortitude saves (DC 14) or take a -1 penalty to attack and damage rolls for 1 minute, if they succeed they are unaffected by this effect for three rounds. This ability can be used once per day.

Devourer
Huge Zerg
Hit Dice: 11d10+22 (82 hp)
Initiative: +2 (Dex)
Speed: 0 ft., fly 40 ft (good).
AC: 17 (+2 Dex, +7 natural, -2 size)
Attacks: Acid spit +12 ranged (60 foot increments).
Damage: Acid spit 2d8 acid (5 foot splash 1d3 acid)
Face/Reach: 10 ft. by 10 ft. /5 ft.
Special Attacks: Acid.
Special Qualities: Zerg traits, damage reduction 10/+2, cold and fire resistance 20, PR 18.
Saves: Fort +9 Ref +8 Will +1
Abilities: Str 13 Dex 12 Con 15 Int 2 Wis 7 Cha 3
Skills: Listen +1, Spot +1, Move Silently +6.
Feats: Zero-g training.
Challenge Rating: 10
Advancement: 12-16 HD (Huge).

Mutalisks can metamorph into another form once they become strong enough (11 HD), which is believed to be based on the defensive form of the mantis screamer.

Combat:

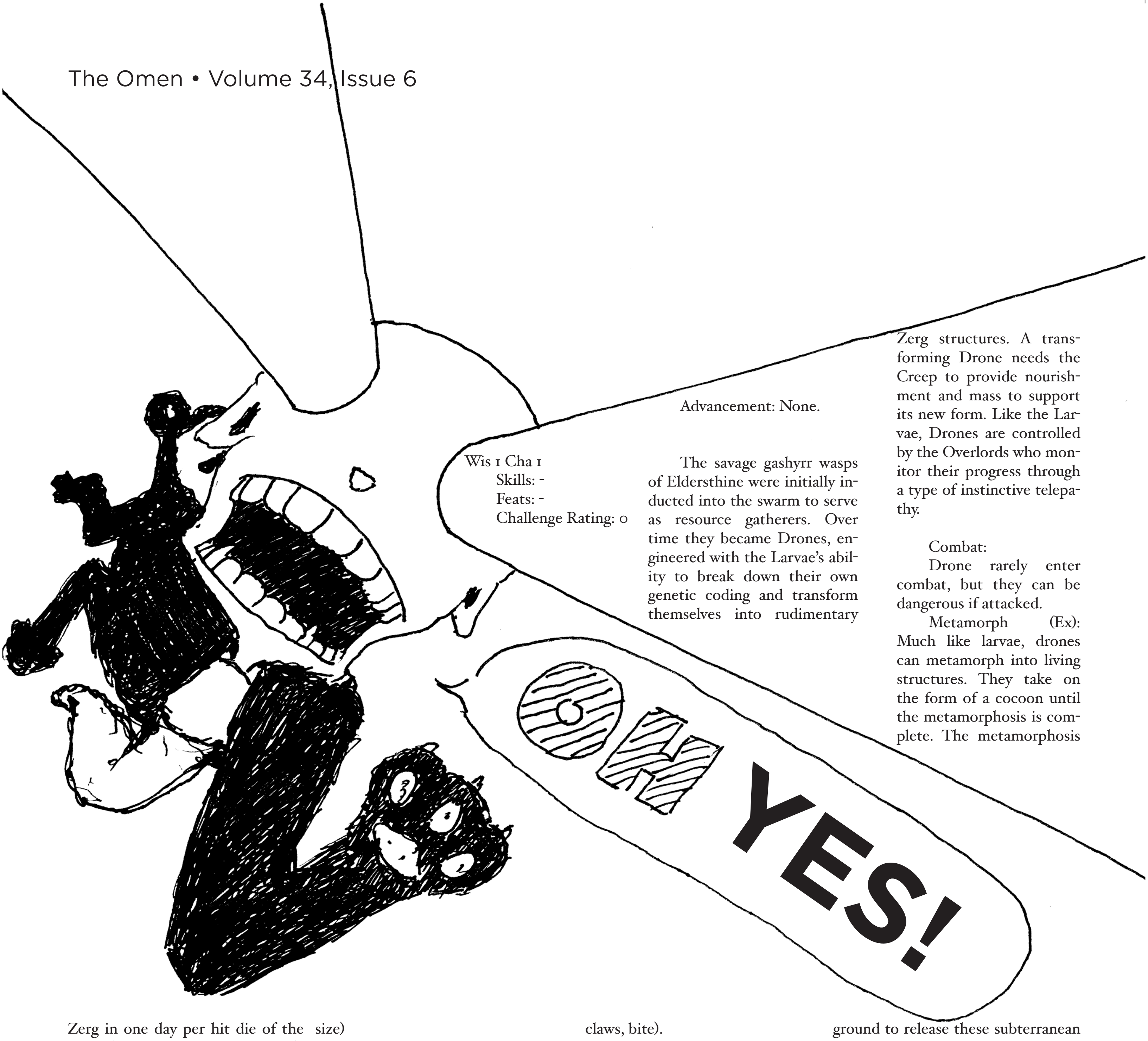
The Zerg devourer attacks by lobbing explosive gobs of acid, much like the guardian.

Acid (Ex): An attack made by a Devourer deals 1d8 acid damage for one extra round, this effect is otherwise identical to Melf's acid arrow. This attack deals 1d3 damage to every creature within 5 feet of the target (reflex save DC 18 negates).

Drone
Small Beast (Zerg)
Hit Dice: 1/2 1d10 (2 hp)
Initiative: +1 (Dex)
Speed: 30 ft. burrow 10 ft.
AC: 14 (+1 Dex, +2 natural, +1 size)
Attacks: 2 claws +0 melee
Damage: Claw 1d4
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits, metamorph.
Saves: Fort +2 Ref +3 Will -3
Abilities: Str 11 Dex 12 Con 10 Int 1 Wis 5 Cha 2
Skills: Listen +1, Spot +1, Climb +4.
Feats: -
Challenge Rating: 1/4
Advancement: 1-3 HD (small).

Cocoon
Large Zerg
Hit Dice: 4d10+8 (30 hp)
Initiative: +0 (Dex)
Speed: -
AC: 16 (+7 natural, -1 size)
Attacks: -
Damage: -
Face/Reach: 2.5 ft. by 2.5 ft. /0 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 5/-.
Saves: Fort +6 Ref +2 Will +1
Abilities: Str 1 Dex - Con 14 Int 1

Zerg D&D.
submitted by Kristian Brevik



Wis 1 Cha 1
Skills: -
Feats: -
Challenge Rating: 0
Advancement: None.

The savage gashyrr wasps of Eldersthine were initially inducted into the swarm to serve as resource gatherers. Over time they became Drones, engineered with the Larvae's ability to break down their own genetic coding and transform themselves into rudimentary Zerg structures. A transforming Drone needs the Creep to provide nourishment and mass to support its new form. Like the Larvae, Drones are controlled by the Overlords who monitor their progress through a type of instinctive telepathy.

Combat:
Drone rarely enter combat, but they can be dangerous if attacked.

Metamorph (Ex): Much like larvae, drones can metamorph into living structures. They take on the form of a cocoon until the metamorphosis is complete. The metamorphosis Zerg in one day per hit die of the breed (combined if more than one). Larva may produce two zerglings or scourges at one time.

Creep dependency (Ex): Larvae and eggs cannot exist away from the creep. Larvae who stray from the Creep and eggs removed from it lose one hit point every round until they die.

Lurker
Large Zerg
Hit Dice: 11d10+11 (71 hp)
Initiative: +2 (Dex)
Speed: 30 ft. burrow 20 ft.
AC: 18 (+2 Dex, +7 natural, -1 size)
Attacks: 2 claws +14 melee and bite +9 melee, or subterranean spines +14 ranged (40 foot line)
Damage: Claw 1d8+2, bite 1d10+2, spines 2d6+3
Face/Reach: 10 ft. by 10 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 10/+2, fire and cold resistance 10, PR 14.
Saves: Fort +5 Ref +6 Will +0
Abilities: Str 15 Dex 14 Con 13 Int 3 Wis 6 Cha 4
Skills: Listen +2, Spot +2, Climb +6.
Feats: Weapon focus (spines, claws, bite).
Challenge Rating: 10
Alignment: Always chaotic evil
Advancement: 12-14 HD (Large), 15-17 HD (Huge).

One of the newer and deadlier Zerg strains, evolved from the Hydralisk, these creatures serve as defense warriors for the hive clusters and outlying Zerg colonies.

Combat:
Bred from the hydralisk strain, lurkers emit waves of supra-dense spines against their enemies. However Lurkers must burrow underground to release these subterranean attacks. These spines are armor piercing, and thus Gain a bonus to attack equal to the target's combined armor and natural armor bonuses (max +3). The attack is compared to the armor class of all creatures in the area and damages all those hit.

Mutalisk
Large Beast (Zerg)
Hit Dice: 7d10+7 (45 hp)
Initiative: +2 (Dex)
Speed: 5 ft. fly 50 ft (average).
AC: 15 (+2 Dex, +4 natural, -1 size)
Attacks: Glave wurm +9 ranged

screamer.

Combat:
The Zerg guardian has a thicker armored carapace and attacks by lobbing explosive gobs of acid.
Acid (Ex): An attack made by a Guardian deals 1d8 acid damage for one extra round, this effect is otherwise identical to Melf's acid arrow.

Hydralisk
Medium-Sized Zerg
Hit Dice: 5d10+5 (32 hp)
Initiative: +2 (Dex)
Speed: 30 ft. burrow 10 ft.
AC: 17 (+2 Dex, +5 natural)
Attacks: 2 claws +9 melee and bite +4 melee, or spine +7 ranged (60 foot increment)
Damage: Claw 1d8+4, bite 1d10+2, spine 1d8+4
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 5/+1, cold and fire resistance 10, PR 12.
Saves: Fort +5 Ref +6 Will +0
Abilities: Str 18 Dex 14 Con 13 Int 3 Wis 8 Cha 4
Skills: Listen +3, Spot +3, Climb +8.
Feats: -
Challenge Rating: 5
Advancement: 6-10 HD (Medium-Sized), 11 HD (becomes a lurker).

The peaceful, herbivore herds of slothien were assimilated into the Zerg swarm in order to produce one of the most fierce and diabolical of the Zerg strains. The evolutionary matrix of the caterpillar-like slothien was supercharged by the Overmind, twisting the hapless creatures into nighmarish killers know as hydralisks. These once mild creatures now hunger for blood and violence, and they are infamous for acting in a particularly sadistic fashion. The spindly, snake-like hydralisks house hundreds of armor piercing spines within their upper carapace plates. These spines can be fired in volleys at enemies at long range.

Combat:
Hydralisks try to soften their opponents with their needle spines before moving into melee, using zerglings to block their enemies advances against them. The hydralisk's spines are armor piercing and thus Gain a bonus to attack equal to the target's combined armor and natural armor bonuses (max +3).

Infested Terran
Medium-Sized Zerg
Hit Dice: 2d10 (11 hp)
Initiative: +1 (Dex)
Speed: 30 ft.
AC: 14 (+4 natural)
Attacks: Slam +3
Damage: Slam 1d6+1
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: Detonate.
Special Qualities: Zerg traits.
Saves: Fort +3 Ref +3 Will -5
Abilities: Str 13 Dex 10 Con 10 Int 4 Wis 1 Cha 1
Skills: Listen +1, Spot +1, Climb +5.
Feats: -
Challenge Rating: 1
Advancement: None.

Once Terran soldiers and civilians, the infested victims of the Zerg are completely consumed by the will of the Overmind.

Combat:
Their bodies twisted and mutated to produce extremely unstable chemicals, infested soldiers long only to find the swarm's enemies and destroy them by detonating their own bodies in a cloud of toxic fluid.
Detonate (Ex): Infested Terrans can detonate themselves, creating an explosion with a 10 foot radius. All creature caught in the blast take 2d6 fire damage, 1d6 piercing damage, and 1d6 acid damage. A successful reflex save (DC 16) halves all damage.

Larva
Tiny Zerg
Hit Dice: 1/4d10+2 (3 hp)
Initiative: -2 (Dex)
Speed: 5 ft.
AC: 14 (+2 natural, +2 size)
Attacks: -
Damage: -
Face/Reach: 2.5 ft. by 2.5 ft. /0 ft.
Special Attacks: -
Special Qualities: Zerg traits, metamorph, damage reduction 5/-, Creep dependency.
Saves: Fort +4 Ref +0 Will -5
Abilities: Str 1 Dex 6 Con 14 Int 1 Wis 1 Cha 1
Skills: -
Feats: -
Challenge Rating: 0
Advancement: None.

Egg
Tiny Zerg
Hit Dice: 1/4d10+2 (3 hp)
Initiative: +0
Speed: -
AC: 16 (+4 natural, +2 size)
Attacks: -
Damage: -
Face/Reach: 2.5 ft. by 2.5 ft. /0 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 10/-, Creep dependency.
Saves: Fort +4 Ref +0 Will +0
Abilities: Str 1 Dex - Con 14 Int 1 Wis 1 Cha 1
Skills: -
Feats: -
Challenge Rating: 0
Advancement: None.

The closest creatures to the original Zerg insectoids are the larvae. Although their size and toughness were greatly boosted by the Xel'Naga during their experiments, they still possess the two traits that originally intrigued the ancient masters: genetic versatility and psychic sensitivity.

Combat:
Larvae do not enter combat and have no attacks of their own.
Metamorph (Ex): Each larvae contains within it the genetic makeup of every other Zerg breed. With a command from the Overmind, the larvae will enter a pupal state and begin the metamorphosis into whichever breed is required by the hive. The larva first takes the form of an egg. The egg then produces one or more

takes one day for every hit die the structure has.

Guardian
Huge Beast (Zerg)
Hit Dice: 11d10+22 (82 hp)
Initiative: +2 (Dex)
Speed: 0 ft. fly 40 ft (good).
AC: 17 (+2 Dex, +7 natural, -2 size)
Attacks: 2 Claws +12, Acid glob +12 ranged (100 foot increments).
Damage: Claw 1d6+1, Acid glob 3d8 acid
Face/Reach: 10 ft. by 10 ft. /5 ft.
Special Attacks: Acid.
Special Qualities: Zerg traits, damage reduction 10/+2, cold and fire resistance 20, PR 18.
Saves: Fort +9 Ref +8 Will +1
Abilities: Str 13 Dex 12 Con 15 Int 2 Wis 7 Cha 3
Skills: Listen +1, Spot +1, Move Silently +6.
Feats: Zero-g training.
Challenge Rating: 11
Advancement: 12-16 HD (Huge).

Mutalisks can metamorph into another form once they become strong enough (11 HD), which is believed to be based on the nesting form of the mantis

(60 foot increments).
Damage: Glave wurm 1d10 plus 1d4 acid
Face/Reach: 10 ft. by 10 ft./5 ft.
Special Attacks: -
Special Qualities: Zerg traits, cold and fire resistance 10, PR 12.
Saves: Fort +6 Ref +7 Will +0
Abilities: Str 11 Dex 15 Con 12 Int 2 Wis 7 Cha 3
Skills: Listen +1, Spot +1, Move Silently +6.
Feats: Zero-g training.
Challenge Rating: 6

Advancement: 8-10 HD (large), 11 HD (becomes a devourer or guardian).

The mutalisk has been little changed from its original form, the roving mantis screamer of the desolate Dinares sector. Capable of both atmo-

spheric and deep space flight, the mutalisks are the primary flying force of the Zerg

Combat:

Mutalisks attack by expelling a voracious symbiote that rapidly slices its way through opposing forces.

Overlord
Gargantuan Zerg
Hit Dice: 14d10+84 (161 hp)
Initiative: -1 (Dex)
Speed: 0 ft., fly 40 ft (good).
AC: 20 (-1 Dex, +13 natural, -4 size)
Attacks: 2 slams +24
Damage: Slam 1d12+10
Face/Reach: 20 ft. by 20 ft. /20 ft.
Special Attacks: -
Special Qualities: Zerg traits, cold and fire resistance 15, PR 18, blindsight.
Saves: Fort +14 Ref +7 Will +3
Abilities: Str 30 Dex 8 Con 22 Int 6 Wis 12 Cha 8
Skills: Listen +15, Spot +15, Search +12.
Feats: Zero-g training.
Challenge Rating: 6
Advancement: 15-21 HD (Gargantuan).

The semi-intelligent, space-faring behemoths know as the gargantis proximae were inducted into the Swarm so that their heightened senses could benefit Zerg warriors in battle. The gargantis flyers were assimilated into the Swarm so well that the cerebrates use them to maintain control over their forces. Overlords keep warriors of the Swarm ordered and coordinated during battle, and with their enhanced senses they often serve as advanced scouts. They have the innate ability to sense any hidden enemy units, including those under the effects of cloaking systems or distortion fields.

Combat:

Overlords tend to stay out of direct combat, instead commanding other warriors and sensing hidden enemies.

Blindsight (Ex): Overlords have blindsight with a range of 1000 feet.

Ventral Sacs (Ex): In addition to commanding troops against their enemies, the Overlords also have the responsibility of transporting Zerg warriors within the hollows of their reinforced carapace hides. An overlord can hold within itself 2 huge creatures, 8 large creatures, 32 medium-sized creatures, or 128 small creatures.

Skills: Overlords receive a +10 bonus on all Listen, Search, and Spot checks.

Queen
Large Zerg
Hit Dice: 5d10 (27 hp)
Initiative: +1 (Dex)
Speed: 10 ft. fly 50 ft (good).
AC: 12 (+1 Dex, +2 natural, -1 size)
Attacks: 2 claws +6
Damage: Claw 1d6+1
Face/Reach: 10 ft. by 10 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits, cold and fire resistance 10, PR 14.
Saves: Fort +4 Ref +5 Will +0
Abilities: Str 12 Dex 13 Con 10 Int 2 Wis 9 Cha 6
Skills: Listen +3, Spot +3, Hide +5.
Feats: Zero-g training.
Challenge Rating: 7
Advancement: 6-8 HD (large).

The Zerg queen does not produce larvae, as her name might suggest, but she has earned her royal status from her ability to spawn numerous other parasitic creatures.

Combat:

The queen has only vary weak claws and since her lightly armored body leaves her vulnerable to attack, she usually stays near the central hive to watch over maturing Zerg.

Parasite (Ex): A Queen can launch a small remora-like creature at an opponent (attack bonus +4). This parasite attaches itself to the targeted creature and slowly drains its life, while at the same time spying on the enemy. Every hour that the creature is attached the creature makes a fortitude save (DC 20) to resist taking 1d3 strength damage. Removing the creature without care kills the creature instantly, but with a successful heal check (DC 20), the creature instead takes 1d4 damage. This ability can be used once per day.

Ensnare (Ex): The Queen sprays her victims with a thick mucous that slows down advancing (or retreating) forces that acts as a tangle-foot bag, except in a 20 foot radius. This ability can be used three times per day.

Spawn Broodling (Ex): The queen launches a small glob of spores at an enemy. The spores attempt to "fertilize" any organic mater that they come in contact with. Victims make a fortitude save (DC 20) to resist. If the save fails the victim is instantly metabolized and used to feed the growth of a pair of broodlings (dealing 1d6 constitution damage), which hatch in one round. Once the Broodlings have hatched the victim makes another fortitude save (DC 24) or dies as the broodlings devour him from the inside. After another round the broodlings are fully developed and ready to fight. This ability can be used once per day.

Roverlisk
Medium-sized Zerg
Hit Dice: 3d10+3 (19 hp)
Initiative: +2 (Dex)
Speed: 40 ft.
AC: 15 (+2 Dex, +3 natural)
Attacks: 2 claws +4, bite +5 melee
Damage: Claw 1d4, bite 1d8
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: -
Special Qualities: Zerg traits, fire and cold resistance 5.
Saves: Fort +4 Ref +5 Will -2
Abilities: Str 15 Dex 14 Con 13 Int 2 Wis 4 Cha 2
Skills: Listen +1, Spot +1, Jump +6.
Feats: Weapon focus (bite).
Challenge Rating: 2
Advancement: 4-5 HD (Medium).

The roverlisk, originally a large blue dog incorporated as an experiment on Bhekar Ro to see how well it would perform, has caught on as a more powerful version of the Zergling. A roverlisk looks like a large blue dog covered in spikes with four eye stalks where its two eyes should be.

Combat:

Roverlisks charge into battle with little thought of strategy and attempt to tear their pray to peaces.

Scourge
Small Zerg
Hit Dice: 1d10+1 (6 hp)
Initiative: -1 (Dex)
Speed: Fly 60 ft. (good)
AC: 13 (-1 Dex, +3 natural, +1 size)
Attacks: -
Damage: -
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: Detonate.

Special Qualities: Zerg traits, blindsight.
Saves: Fort +3 Ref +1 Will -2
Abilities: Str 4 Dex 8 Con 12 Int 1 Wis 3 Cha 1
Skills: Hide +4, Move Silently +4.
Feats: Zero-g training.
Challenge Rating: 1
Advancement: -

Scourges are blind terrors that seek out enemy spacecraft and dive into them. Catalytic agents found within the body of the scourge cause it to explode like a living plasma bomb when it smashes itself against an enemy.

Combat:
Scourges charge into large groups of enemies or single large enemies and detonate themselves.
Blindsight (Ex): Scourges have blindsight with a range of 200 feet.
Detonate (Ex): Scourges can detonate themselves, creating an explosion with a 10 foot radius. All creature caught in the blast take 2d6 energy damage, 1d6 ballistic damage, and 1d6 acid damage. A successful reflex save (DC 18) halves all damage.

Ultralisk
Huge Zerg
Hit Dice: 16d10+48 (136 hp)
Initiative: +1 (Dex)
Speed: 60 ft.
AC: 22 (+1 Dex, +13 natural, -2 size)
Attacks: 2 kaiser blades +25 melee
Damage: Kaiser blade 4d8+8
Face/Reach: 10 ft. by 20 ft. /10 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 20/+4, cold and fire resistance 20, PR 20.
Saves: Fort +10 Ref +11 Will +3
Abilities: Str 27 Dex 12 Con 18 Int 2 Wis 7 Cha 5
Skills: Listen +1, Spot +1, Climb +16.
Feats: Weapon focus (kaiser blade)
Climate/Terrain: Any Land and underground
Organization: Unknown
Challenge Rating: 15
Treasure: None
Alignment: Always chaotic evil
Advancement: 17-21 HD (huge), 22-26 (gargantuan).

Baring little resemblance to the docile brontolith that they were evolved from, the dreaded ultralisk is the most powerful of the Zerg ground forces. They serve as the backbone of the Swarm's armies and should be considered as dangerous as any armored vehicle.

Combat:
These massive monstrosities are used as living battering rams against all manner of enemies. The large bone-like scythes that protrude from their backs are nearly indestructible, allowing them to tear through most known substances with ease.

Zergling
Small Zerg
Hit Dice: 1d10 (5 hp)
Initiative: +2 (Dex)
Speed: 40 ft. burrow 20 ft.
AC: 14 (+2 Dex, +1 natural, +1 size)
Attacks: 2 claws +3, bite -3 melee
Damage: Claw 1d3+1, bite 1d8
Face/Reach: 5 ft. by 5 ft. /5 ft.
Special Attacks: Leaping charge, adrenal glands (3 HD or higher only).
Special Qualities: Zerg traits.
Saves: Fort +2 Ref +4 Will -2
Abilities: Str 12 Dex 14 Con 10 Int 1 Wis 6 Cha 3
Skills: Listen +2, Spot +2, Jump +5.
Feats: Weapon Finesse (claw), improved init. (2 HD or higher only).
Challenge Rating: 1/2
Advancement: 2-4 HD (Small).

The small, savage dune-runners of the sand-world Zz'gash were incorporated into the Zerg swarms to serve as scouts and initial assault troops.

Combat:
Although the zerglings are little more then feral animals, they work well in large groups under the command of larger Zerg warriors. The voracious zerglings are found of ripping enemies to shreds with their razor-limb sickles and fangs.
Leaping charge (Ex): A zergling that charges can make a full attack action with it's natural weapons instead of one attack.
Improved initiative (Ex): Zerglings that advance to 2 HD gain improved initiative as a bonus feat.
Adrenal Glands (Ex): Zerglings that advance to 3 HD gain the ability to make one additional claw attack at their regular attack bonus minus 5 each round.

Basic Structure
Large Zerg
Hit Dice: 4d10+8 (30 hp)
Initiative: +0 (Dex)
Speed: -
AC: 16 (+7 natural, -1 size)
Attacks: -
Damage: -
Face/Reach: 2.5 ft. by 2.5 ft. /0 ft.
Special Attacks: -
Special Qualities: Zerg traits, damage reduction 5/-.
Saves: Fort +6 Ref +2 Will +1
Abilities: Str 1 Dex - Con 14 Int 1 Wis 1 Cha 1
Skills: -
Feats: -
Challenge Rating: 2 plus enhancements (0 with none)
Advancement: 5-8 HD (Large), 9-14 HD (Huge), 15-22 HD (Gargantuan), 23+ (Colossal).

Drones may metamorph into living structures that have a variety of functions. The statistics for a basic structure appear above. Structures may be enhanced by any of the following abilities:
Corrosive spores (Ex): The structure may fire a corrosive spore as a ranged attack with a range increment of 50 feet. This attack deals 2d8 acid damage, and 1d8 acid damage on the following round. The structure has an effective 14 dexterity when attacking with these spores. This adds 2 to the structure's challenge rating.
Creep production (Ex): The structure produces Creep in a 100-foot radius around it. This does not change the structure's challenge rating.
Enhanced hit dice (Ex): The structure gains additional hit dice. This adds 1 to the structure's challenge rating for every two hit dice added.
Larvae production (Ex): The structure produces a single larva every hour. This adds 2 to the structure's challenge rating.
Subterranean spine (Ex): The structure may extend a spiked tentacle through the Creep up to 100 feet away (though not extending beyond the creep). This is considered a melee attack that deals 4d8+3 damage. The structure has an effective 14 strength when attacking with this tentacle. This adds 3 to the structure's challenge rating.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